### ISTORIC FOUNDATIONS

OF

### BOTANY

IN

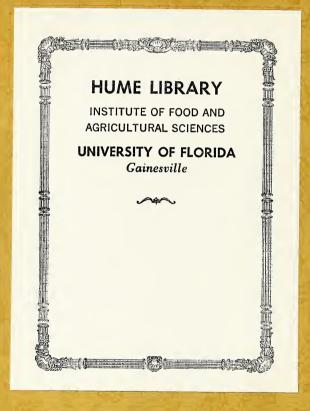
FLORIDA (AND AMERICA)

BY

WILLIAM ALPHONSO MURRILL, A.M., Ph.D.



GAINESVILLE, FLA.
Published by the Author
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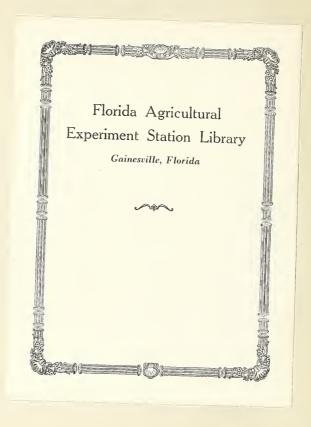
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WILLIAM ALPHONSO MURRILL, A.M., Ph.D.



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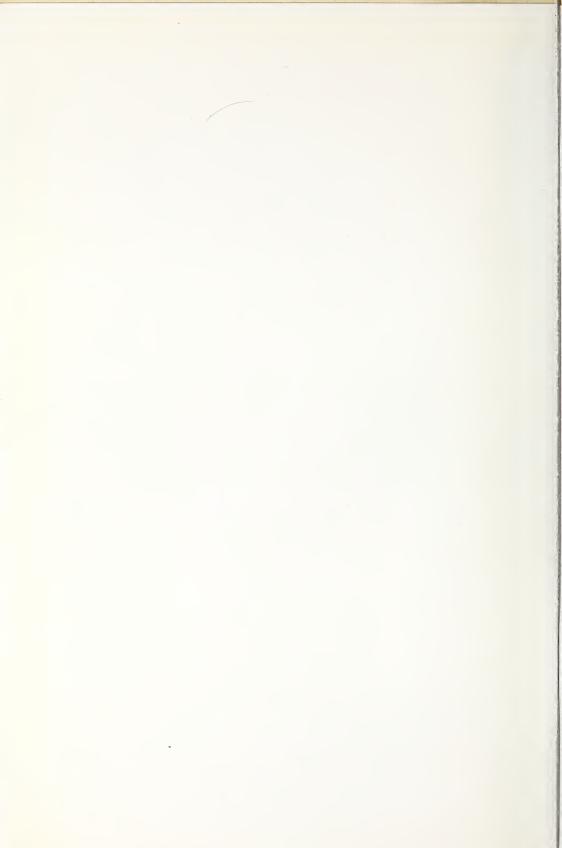
#### PREFACE

History is mainly a record of the achievements of great men. Such men usually had more or less help from others but they were the planners, the leaders and the inspiration.

The author has met many leading botanists, both in New York and on his extensive travels in the Americas and Europe. It would be interesting to record his impressions of them but the story would be too long and the risk too great.

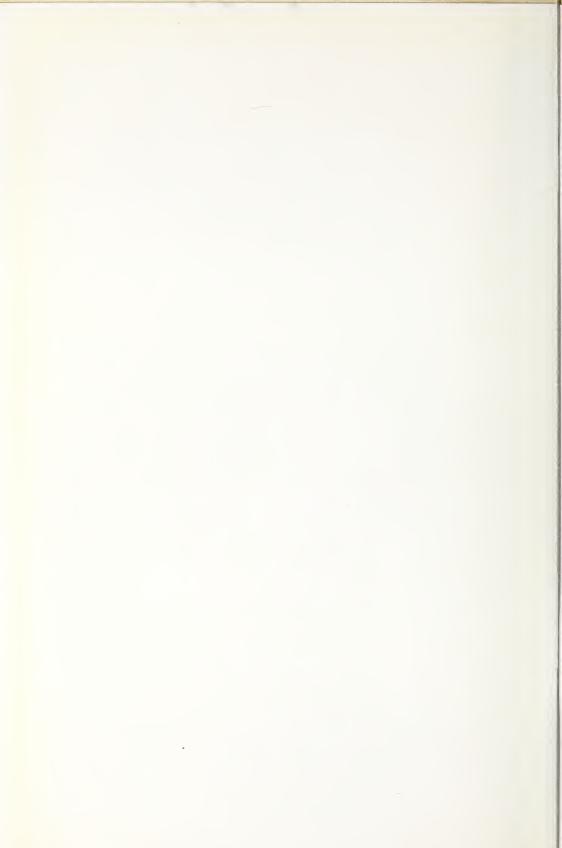
W. A. MURRILL

Gainesville, Florida August 1, 1942



#### CONTENTS

Chapte	er -	Page
I.	Introduction.	. 5
II.	EARLY AMERICAN BOTANY	. 9
III.	FLORIDA PLANTS NAMED FOR BOTANISTS	. 14
IV.	Modern American Botany	. 16
V.	Cryptogams	. 21
VI.	Fungi	. 26
VII.	PLANT PATHOLOGY	. 33
VIII.	The Field of Botany	. 38
IX.	BOTANICAL EDUCATION IN FLORIDA	. 44
X.	FLORIDA TOMORROW	. 49
XI	THE WORLD TOMORROW	50



# Historic Foundations of Botany in Florida (and America)

#### CHAPTER I

#### INTRODUCTION

#### FLORIDA GEOLOGY

Florida geology begins with the Tertiary age, which includes the Eocene, Oligocene, Miocene and Pliocene periods. It was during this age that trees of modern types, such as the oaks and palms, joined the conifers to make forests, and birds appeared to distribute their seeds. In the Eocene the arctic regions contained forests of beech, oak, magnolia, maple, and other hardwood trees similar to those found in our hammocks today but differing specifically; while along the upper Missouri the climate was then as warm as eastern North Carolina is now and remained so until the close of the Tertiary. After the Eocene period an elevation occurred along the Gulf border in Mississippi, Alabama and northwest Georgia, and by the end of the Tertiary the outline of our continent was about completed.

The Pleistocene, or Glacial, period destroyed life over a wide area, made extensive topographic changes, and prepared the continent for the advent of man. Species of plants and animals existing in the Quaternary age are still with us, most of them, in

spite of man's destructive tendencies.

The Eocene series is represented by the Ocala limestone, which is light in color and almost chemically pure calcium carbonate. It is 150 to 400 feet thick in the peninsula and outcrops in many places. The Oligocene series, represented by the Vicksburg group, overlies the ocala limestone in a conformable stratum 30 to 150 feet thick. The Hawthorn formation of this period consists of yellow limestones, greenish or reddish sands and green clays. All of our large springs and many flowing

wells are found in the Eocene and Oligocene series.

The Miocene series is well represented by the limestones of the Tampa formation, exposed near Tampa and along the Suwannee river. In north-central Florida this series is thin but widely spread. The Pliocene of Florida is comparatively unimportant, consisting mostly of marine and freshwater sediments, such as the Alachua clays, with marl, gravel and some hardrock phosphates. These clays contain considerable sand and are greenish in color, weathering yellow or red. They have an important bearing on vegetation because they hold the surface water. The Pleistocene series, rarely over 100 feet thick, occurs along the coast and in the southern part of the state, represented by coquina, Miami oölite and other recent formations. It was during this period that the southern quarter of peninsular Florida and the keys emerged from the ocean.

The introduction of northern species occurred during successive periods of glaciation in the Pleistocene period, either gradually by ordinary methods of distribution or carried by flood waters from the higher elevations to the new lowlands that were to be called "Florida." After that it became a question of adaption, struggle for existence, and the survival of the fittest. When man appeared with his deadly weapon, fire, vast areas of hardwood trees were destroyed, their places were

taken by pines, and the remnant found refuge in the moist hammocks.

#### TROPICAL AMERICAN GEOLOGY

Since a large number of our plants have come from tropical America it may be well to give a brief outline of the geologic changes that have taken place in the lands to the south of us. A fundamental difference may be stated first. In the northern

hemisphere there were land connections around the globe that permitted free plant migration, while south of the equator there were no such land-bridges to connect South America with other continents. In the Miocene, Greenland became separated from Norway, thus not only severing a bridge that had existed for a long time but allowing arctic currents to bathe the Atlantic Coast and decidedly affect its flora.

When the Rocky Mountains were formed, the great forests to the east of them had to give place to grasses for lack of sufficient rain and these prairies have existed ever since. A barrier was thus set up against free plant migration to the southwest and Mexico. One sees about Mexico City great cypress trees much like our own southern cypress but differing specifically because of this barrier.

A similar condition exists today in Argentina. The elevation of the Andes in the Pliocene cut off the rain-bearing winds from the great plains to the east and produced the pampas, leaving the dense rain-forests only on the western side, in Chile. Thus forests of vast extent, with all the tolerant plants that the word forest connotes,

were blotted out simply by a fold in the earth's crust.

In the West Indies and northern South America there was plant destruction by another fold, allowing the ocean to overflow the land and destroy its vegetation utterly. In the late Mesozoic the highlands of Honduras were connected in an unbroken land-bridge across Jamaica, Haïti and Porto Rico; but during most of the Cenozoic this region was under water and began to emerge only in the Pliocene. It must be remembered, however, that Mexico and Central America still supported a vast and varied flora, and from this flora many of our southern plants have originated. Although Dryophyllum, the ancestral stock of oak, chestnut and beech, was probably northern in origin, three hundred species of oaks have been reported from Central America, which may have been the home of our southern live-oak.

In the Cretaceous, plants were widely distributed over the world because of prevailing warm climates, low elevations, abundant moisture, bees and butterflies

to cross-pollinate, and seeds to afford efficient means of transportation.

According to Schuchert, a small portion of Florida arose as an island during the Oligocene and ocean currents brought to it from tropical lands various species of plants that became the foundation elements of the flora we are studying today. But others oppose this view, on the ground that Florida was almost certainly com-pletely submerged again in the Middle and Upper Miocene, so that the Oligocene

Island has no bearing on any modern biotic problem.

Mr. S. A. Stubbs, formerly of the Florida State Museum, has obtained results from many borings in Florida that confirm this latter opinion. He says that in the Lower Pliocene, and possibly in the Late Miocene, there were probably in this region chains of keys or small islands that could have received plants from the lands to the south. Moreover, he claims that the evidence points to a warm ocean current setting northward through these keys at the time, with a colder descending current

to the north of it.

In abandoning the "Oligocene Island" theory, we might possibly substitute the words "Pliocene Islands," and continue the line of reasoning previously used, because during this period there were tropical lands to the south, even nearer than during the Oligocene, containing a great profusion of plants, and there were warm ocean currents to distribute them. In the Upper Miocene, Cuba was emergent and began to receive migrants from tropical America, which were doubtless passed on to Florida. We know that, after the southern tip of Florida emerged, a large percentage of its plant species came from Cuba. The Bahamas are really a continuation of Florida, and Cuba was never connected with either.

Let us not get the idea, however, that the Oligocene Island is a myth. It not only existed for a long period of years but also must have been covered with a rich and varied flora. If the Miocene submergence was as complete as some of us believe, this flora must have been wiped out utterly; but who knows how much of it in the meantime may have migrated northward only to return on the cool descending

current of the Pliocene to the very region where it originated!

#### FOSSIL PLANTS OF THE LOWER SOUTH

The first known land plants appeared on the earth in the Silurian Age and until the Cretaceous period the dominant plants were spore-bearing, like the ferns, and plants with naked seeds, like the cycads and conifers. Flowering plants, or angiosperms, with enclosed seeds, appeared in the Jurassic in forms like Caytonia and Gristhorpia and as early as the Upper Cretaceous had dominated the flora of the world, their dominance being disputed only by the conifers, which were especially adapted to cold climates. The period also saw a great development of the palms, adapted especially to warm climates. The number of plant species had jumped from about 12,000 in the Devonian to at least 100,000 in this period, and in America

a rich and varied flora extended from Canada to Central Argentina.

In the early Tertiary, during the Eocene and Oligocene periods, the angiosperms continued their triumphal progress, aided by the widespread favorable climate. Fruits and grasses, including the cereals, came into prominence at this time. Greenland supported a large temperate flora containing such arborescent forms as the oak, tulip, ginkgo, sequoia, hickory, sassafras and magnolia. On the southern Coastal Plain a totally different flora, rich in species, flourished from North Carolina to Texas. There were changes of level, the ocean at times reaching as far as southern Illinois, but for the most part this sandy plain was low, flat, warm, and well supplied with ponds and swamps. Over six hundred fossil species have been studied from this region, representing three distinct floras.

The Wilcox Flora included many tree types now found in Central America, northern South America and the West Indies. Representing this flora are specimens of cypress, zamia, palms, figs, breadfruit, papaw, soapberry, ash, tupelo, acacia, redbud, red bay, hickory, wax myrtle, cedar, a modern oak, and Dryophyllum, the

supposed ancester of all our oaks, chestnuts and beeches.

The Claiborne Flora is not so rich as the Wilcox. Many of the previous generic types lived on, but the species were changed. Three or four new conifers appeared, together with Citrophyllum, the ancestral type of oranges and lemons. The Jackson Flora really represented a beach jungle under tropical or subtropical conditions. Palms were abundant, including a date palm, which later disappeared. Other common genera were Diospyros, Nyssa, Ceanothus, Tilia, Planera, Smilax and Sapindus. Our southern tulip-tree probably originated in New Jersey in the upper Cretaceous and spread widely during the early Tertiary. In the Miocene period

there was a culmination of land floras.

A change came over the world in the Pliocene. It got colder, for some reason; perhaps owing to the elevation of the land. Plants that had been comfortable near the North Pole had to seek a warmer climate. One avenue of escape was through northern China, another through Scandinavia to central Europe, and a third by way of the Alleghanies to the southern states. The situation became more acute in the Pleistocene, when great glaciers stretched southward, killing nearly everything The northern migrants mingled with the native flora and have rein their path. mained until the present time. During the interglacial periods, when it got too warm for them in the lowlands, they climbed the mountains of the southern Alleghanies and found there congenial homes until a return of glaciation tempted, or drove, them back to the valleys again. This explains why we find subboreal types isolated on our southern mountain tops.

The herbaceous flowering plants were not present during the warmer geologic periods that developed luxuriant floras of trees and shrubs but appeared only in the colder parts of the Tertiary when plants had to dig in of necessity to escape freezing or drought. An upstanding stem might not survive such conditions of stress but a perennial herb could live on in underground rootstock or bulb; while an annual could die and leave behind it numbers of tiny progeny wrapped up safe and sound in seeds. Herbs could grow under the summer sun and take a needed rest while winter raged. In Greenland over 90% of the flowering plants are herbs; in the lowlands of

the Amazon only 12%.

Florida vegetation, like the population, is decidedly complex both in character and origin. Some of our plants migrated long ago from tropical America and remained practically unchanged. This is true of the majority of species in the southern, tropical tip of the peninsula. Others, of older and more widely extending migrations from tropical America, have become so changed under new conditions that they

are now recognized as distinct species.

After Florida became connected with the mainland, and especially during periods of glaciation in the Pleistocene period, there was an influx of temperate species from the northern states. Many of these remain unchanged today in northern and western Florida while others have changed under new conditions to different species or varieties.

A final addition to our flora was brought about by human agency. The aborigines introduced a few plants, the white man many. At the present time a large proportion of our vegetation consists of weeds and exotic plants under cultivation.

#### TOPOGRAPHY

The northern boundary line of Florida is about 400 miles; the peninsula 375 miles long and less than 100 wide; the coastline 1.145 miles; and the area 58,666 square miles. The topography is quite unique. The northwest is hilly and rolling, the east side a coastal plain, the peninsula a mixture of sand and marsh with a 300-foot ridge down the center terraced on both sides.

#### WATER RESOURCES

There are more than 30,000 lakes in Florida. mostly depressions caused by solution of the underlying limestone. The largest is Okeechobee, 730 square miles or more in extent. St. John's River is the dominant stream of the east coast. It is navigable nearly to its source, a distance of 200 miles or more. St. Mary's rises in the great Okefenokee Swamp and reaches the Atlantic at St. Mary's Entrance. The rivers of western and southern Florida emptying into the Gulf, are chiefly the Caloosahatchee, Withlacoochee, Suwannee, Ochlockonee. Apalachicola, Choctawatchee, Escambia and Perdido.

Some of the largest limestone springs in the country are located in Florida. They originated as a series of sinkholes along the couse of underground streams when the water table stood at least 80 feet below its present level. The source of the water, of course, is rain which falls on the highlands and seeps down through the sand into cavities in the Ocala limestone, then flows underground before emerging as crystal-clear spring water. Silver Springs, near Ocala, sends out 370,000 gallons per minute; Rainbow Springs 350,000 gallons; Crystal Spring 200,000; Itchatucknee 153,000; Wakulla 150,000; and twenty others from 15,000 up to 150,000 gallons.

#### SOILS

The foundation rock is limestone and over it are other limestones, marls, sands, clays, etc. The soils are surface deposits only. Limestone and sand are widespread. Pineland soils contain sand and humus; hammock soils have humus with marls and clays; while most swamp-land soils contain muck and peat. A good soil map is available giving details.

#### MINERALS

The principal minerals are three kinds of phosphate rock, fullers' earth, kaolin and limestone. The ancient igneous rocks have been reached only in one very deep well. There is no coal or precious metals.

#### FOREST RESOURCES

Forestry is Florida's largest industry, employing over 70,000 persons and yielding 30 per cent of all the earned wealth. Of the 35 million acres of land in the state 23 million are forest lands. However, Florida is fully fifteen years behind the other southern states in the development of its forest resources. In agriculture and horticulture much more progress has been made.

#### CLIMATE

Florida has short, mild winters and a summer climate that compares favorably with that of other states, especially on the numerous bathing beaches. The frequent summer rains are largely responsible for the moderate summer heat and the cool nights. There is much less rain during the winter.

#### POPULATION

When Florida was acquired by the United States about 1820 there were less than 5,000 white people in it. The chief settlements were at St. Augustine, Fernandina, St. Marks. Apalachicola and Pensacola. In 1830 there were 18,000 whites and 16,000 negroes. Planters raised cotton, sugarcane, indigo, rice, sweet potatoes and, at a later period, tobacco. When Florida became a state in 1845 immigration increased rapidly but declined after the Civil War until near the close of the century. The 1940 census showed a density of 32.2 persons per square mile, or about 1,888,000 population.

#### HISTORY

The first white settlement was made at St. Augustine in 1513. A hundred years later the Spandiards had only three small fortified posts and a few missions

among the natives. In 1763 Florida was ceded to Great Britain and a period of great prosperity began, with 25,000 white immigrants from nearby states. But in 1788

the Spanish took over again and many of the whites left.

In 1810 the United States threw a protecting arm over West Florida; in 1815 Spain ceded all of Florida to the United States; in 1822 it became a territory; in 1845 a state; and in 1861 a Confederate state. Florida has mostly had a hard time financially. Toward the end of the nineteenth century, however, phosphate rock was discovered, railways were built and tourists began to arrive. But then came the two great freezes, which killed 75% of the orange trees. Twenty-five years later it was the boom in real estate with its tragic reaction, and on top of that the great hurricane in 1926 and the medfly in 1929. Otherwise, things have been pretty quiet—except for a few mosquitoes, redbugs, hookworms and unmentionable germs.

#### CHAPTER II

#### EARLY AMERICAN BOTANY

Columbus on his second voyage sent back many specimens illustrating the vegetable products of the newly discovered lands, and his example was followed by other explorers. Thus the earliest knowledge of American plants was obtained from the accounts of observant travelers, from the specimens they secured and from living

plants transplanted to European gardens or grown from seeds.

Juan Ponce de Leon was born in Spain about 1460 and accompanied Columbus on his second voyage in 1493 as a professional soldier. In Puerto Rico he heard of Bimini and its fountain of youth, so he sailed in search of it. On April 8, 1513, he landed north of the present site of St. Augustine and took possession. He died in 1521, from an arrow wound received in Florida, which he always believed to be an island.

Hernando de Soto was born about 1496 in Spain and because of his wealth was appointed governor of Cuba in 1537 with authority to explore and conquer Florida at his own expense. He shipped from Spain in 1538 with about a thousand men and landed at Tampa Bay the following year. Three years were spent in the interior of the southern states on a fruitless hunt for gold, when the party finally sighted the Mississippi River. The ambitious leader died in 1542 and was buried in its waters.

Early resident workers on the flora of America were all Europeans by birth and naturally sent their specimens to Europe for description, while many collectors from other lands came to gather specimens and take them back home where they were studied by European botanists. Linnaeus, the father of modern botany, obtained his knowledge of American plants largely from specimens cultivated in Europe and from American correspondents like Dr. Alexander Garden, of Charleston, Dr. John Mitchell, of Urbanna, Va., and Dr. Cadwalader Colden, of New York. Shortly before his epoch-making work on species was published his pupil, Peter Kalm, made important collections in this country, the genus Kalmia being dedicated to him.

Mark Catesby spent from 1712 to 1719 in Virginia collecting plants which he

Mark Catesby spent from 1712 to 1719 in Virginia collecting plants which he sent back to England. In 1722 he began collecting and painting the plants and animals about Charleston, where he spent four years and then visited Georgia, Florida and the Bahamas. After returning to England in 1726 he devoted twenty years to the preparation of his "Natural History of Carolina, Florida and the Bahamas," even making the engraving blocks himself. Eleven parts of this work, each with twenty plates accompanied by descriptive text, appeared from 1730 to 1748. His collections are partly in the Sloane Herbarium and the remainder in the Sherard Herbarium at Oxford. John Clayton sent many plants from Virginia to Gronovius, a Dutch botanist, who published them between 1739 and 1743. American collections used by Ray, Petiver, Gronovius and Linnaeus in their botanical publications are all in England, mostly at the British Museum.

John Mitchell was born in England about 1680 and died in 1768. He came to the United States as a physician in 1700 and settled in Urbanna, Va., on the Rappahannock River. His large plant collections were sent to Linnaeus, who named the genus *Mitchella* for him. *M. repens* is a common and attractive feature of the

hammocks in northern Florida.

Philip Miller was born in 1691 in London, England, where his father was gardener in a splendid garden for apothecaries. In 1722 he succeeded him and held the position for fifty years, being considered the most famous gardener of his day. His

"Gardener's Dictionary" was a most useful work.

Carl Linnaeus was born in 1707 at Rashult, Sweden, and studied at the universities in Lund and Upsala. Although making a living as a physician, his chief object in life was to learn more and more about nature. From 1741 until his death in 1778 he was a professor in the University of Upsala. He also had a beautiful country home at Hammarby. The most famous of his many books is the "Species Plantarum," published in 1753. His artificial sexual system of plant classification was used for nearly a century, until it was supplanted by the natural system of Jussieu. Few biographies are more romantic and inspiring than the story of this poor, handsome young man who became the "father of modern botany." I have read all I could find about him and have visited most of the places connected with his life.

John Ellis was born in Ireland about 1710 and became a wealthy London merchant. In 1751 he began to study marine algae and later was interested in fungi and flowering plants. In 1764 he was appointed King's Agent for West Florida and during the next six years sent many seeds and useful plants to England. He corresponded with Linnaeus and also with Dr. Alexander Garden, of Charleston.

The first native American botanist was John Bartram, born near Darby, Pa., in 1699. He was a farmer for several years, then a self-taught botanist who traveled extensively from New York to Florida and corresponded with Collinson and other plant lovers in London. About 1729 he established the first botanical garden in America at Kingsessing, then only a suburb of Philadelphia but now a public park with Bartram's old house and many of his shrubs and trees. For nearly fifty years he continued to send seeds and plants to European gardens while retaining many choice specimens for his own, and with the plants went rich stores of information and descriptive notes. In 1765 he was appointed King's Botanist and given a small salary, which enabled him for the next two years to undertake the exploration of the St. John's River and several of its tributaries.

William Bartram was better educated than his father and had considerable artistic ability. After spending some years in business, which was not at all to his taste, he joined his father on the Florida trip and afterwards remained a year as a settler on the St. John's. From 1773 to 1778 he traveled in the Carolinas, Georgia and Florida and published his famous book in 1791. The remainder of his life was spent in studying at the Bartram garden in Kingsessing, where he died in 1823. The Bartram oak, so long a mystery, was grown from seeds at the New York Botanical Garden and found to be a hybrid between the willow oak and the northern

red oak.

Thomas Walter was born in Hampshire, England, about 1740 and settled in South Carolina early in life as a planter. He prepared a splendid account of the plants of the region which was published in London in 1788 by John Fraser under the title "Flora Caroliniana." This was a remarkable work for a man so entirely isolated. In 1789 he was buried in his botanical garden, the second established in America, and his collections are still to be seen in the British National Museum. Walter's house was not far from the bank of the Santee River in St. John's Parish. After the place was abandoned the building soon collapsed and even the ruins disappeared. Vandals broke the marble slab on his grave. About 1930 this slab was

repaired and the grave fenced, but it lies in a forest wilderness.

The first botanical work published in this country was by Humphry Marshall. Other publications followed at intervals but still the main work was done by Europeans. The first botanist who attempted to publish descriptions of all known North American plants was André Michaux, born near Versailles, France, in 1746. After considerable experience in Persian exploration he was sent to the United States by the French Government as a botanical explorer and in 1786 established a nursery at Charleston where plants could be grown and held until shipment. He made Charleston his headquarters until the nursey was sold in 1792. In 1796 he returned to France and died in Madagascar in 1802. A year later his "Flora of North America" appeared in Paris, where his herbarium may still be seen. His collections included living and dried specimens found on his travels from Hudson Bay to Florida and westward to the Mississippi River. His flora was edited by the French botanist L. C. Richard.

François André Michaux came with his father to America in 1785, when he was only fifteen, and remained five years. From 1801 to 1803 he was here again, with

headquarters at Charleston, and explored the region from New York to South Carolina and parts of Kentucky and Tennessee. From 1806 to 1809 he traveled from Maine to Georgia and westward to Ohio. He was most interested in our forest trees and published an elaborate account of them. He also left with the American Philosophical Society, at Philadelphia, a fund for the development of American arboriculture. On returning to France in 1809 he cultivated a number of American trees and distributed them. His death occurred suddenly on his French estate in 1855.

Michaux's "Flora" was followed after an interval of about ten years by that of Pursh, based upon twelve years of collecting. It was in English. These two works were the standard floras of North America for many years, the former more reliable,

the latter more complete.

Frederick Pursh was born in Saxony in 1774, the German form of his name being Pursch. He studied botany and horticulture at Dresden and in 1799 came to Baltimore to establish a garden. While working in the United States twelve years as gardener and landscape architect he traveled widely and made good use of his opportunities for collecting plants and examining existing collections. The southern Alleghanies were visited by him in 1805. From 1807 to 1810 he was in charge of the famous Elgin Botanical Garden in New York City. In 1810–11 he went to the West Indies. His "Flora of North America" was published in England in 1814, in two volumes, with the assistance of the botanist Lambert. Pursh died in Canada in 1820 and in 1878 a monument was erected to him by the Natural History Society of Montreal.

Nathaniel A. Ware (1780-1854) was probably a native of Massachusetts but most of his life was spent in the southern states. He studied law in South Carolina but settled at Natchez, Mississippi, prior to 1817 and became wealthy. Many species of plants collected by him in Florida were described by Nuttall, who dedi-

cated the cruciferous genus Warea to him.

Early in the nineteenth century there were two important centers of botanical activity in the United States, one at Philadelphia and the other at New York. Henry Muhlenberg, a Lutheran clergyman born in Pennsylvania and educated in Germany, figured prominently in the former. Dr. B. S. Barton, a professor in the University of Pennsylvania, also exercised much influence. Among his students was William Baldwin, born in Chester Co., Pennsylvania, in 1779, and later a surgeon in the U. S. Navy stationed at Georgia and Florida ports. From March to May, 1817, he explored Florida botanically. Soon afterwards he was appointed surgeon

and botanist to Long's Expedition up the Missouri River.

Lewis David de Schweinitz, also of the Philadelphia group, was born in Bethlehem, Pennsylvania, in 1780 and educated in Germany (1798–1812) for the Moravian ministry. For some years he held a pastorate in Salem, N. C., but returned to Bethlehem in 1821. Like many ministers, and especially physicians, he was much interested in plants and made the largest collection in the country at the time. This he donated to the Philadelphia Academy of Natural Science, where it is still treasured. In addition to his work on flowering plants he was an outstanding student of the fungi, publishing two important books on the subject. His "Fungi of North Carolina" appeared in 1882 and his "Fungi of North America" about ten years later. His death occurred in 1834.

The leader of the New York group of botanists was Dr. Samuel L. Mitchill, President of the Lyceum of Natural History, who exercised a great influence on young men having a love for nature. David Hosack established the very popular Elgin Botanical Garden, the first in New York. In 1811 this was sold to the state and granted to Columbia College. Later the land became so valuable that it was

disposed of for a large sum.

John Torrey was one of the founders of the Lyceum. Born in New York City in 1796, he became interested as a boy in botany and chemistry. At the age of twenty he entered the College of Physicians and Surgeons and was granted his M.D. degree in 1818. When only 21 he prepared a catalog of the plants growing wild within thirty miles of New York. From 1827 to 1855 he taught chemistry and botany in the College of Physicians and Surgeons and became the first president of the Torrey Botanical Club. His herbarium and library were donated to Columbia College, where he died in 1873.

Another early member of the Lyceum was Prof. C. S. Rafinesque. The father of this eccentric individual was a French merchant and his mother of German extraction; he was born in Constantinople and spent most of his early years in Italy. In

1815 he settled in America and taught in Transylvania University, being the first resident botanist west of the Alleghanies. His later years were spent in Philadelphia, where he died in poverty. Hidden among his many worthless writings there are some of considerable value. Whem Small began to use his generic names a storm of

protest arose from many quarters.

While considering the influence of the Lyceum, which later became the New York Academy of Sciences, we must not overlook the remarkable work of Stephen Elliott on the flora of South Carolina and Georgia. This gifted man was born at Beaufort, S. C., in 1771 and graduated at Yale in 1791. His business was politics and banking but plants were his first love. His botanical "sketch" comprises two volumes filled with pertinent and accurate original observations. Twelve plates made from his own drawings were used to illustrate the 130 pages of descriptive matter. His herbarium is now in the Charleston Museum. At his death in 1830 he was buried in St. Paul's Churchyard but the grave was unmarked and later forgotten. In 1933 a simple monument was erected over it bearing the inscription "Botanist, banker, planter, legislator, teacher." The last title refers to his professorship in the Medical College of Charleston.

Thomas Nuttall, born in England in 1786, was a journeyman printer by trade but took a keen interest in plants. He spent thirty-three years in the United States, from 1808 to 1841, during which time he did much collecting over a wide area. In addition to his book on the "Genera of North American Plants," published in 1818, he wrote many botanical articles. Returning to England in 1841, he died there in

1859

Henry Perrine was born at New Brunswick, N. J., in 1797 and studied medicine in Philadelphia. About 1839 he settled on Indian Key and the following year was killed by the Indians, his house burned and all his manuscripts and specimens

destroyed.

Jean Louis Berlandier was born at Ghent, Belgium, about the beginning of the nineteenth century and died in 1851. From 1823 to 1826 he studied Ribes under de Candolle at Geneva. Later he settled for life at Matamoros, Mexico, as an apothecary and made large plant collections in Mexico and western Texas. His manuscripts and drawings are at Harvard. The genus Berlandiera, so well represented in Florida, was dedicated to him by de Candolle.

Gilbert White Hulse was born in Orange Co., N. Y., in 1807 and received the M.D. degree at the College of Physicians and Surgeons in 1835. As an army doctor he was stationed at Tampa Bay and Fort Brooke in 1836 and at Fort Brooke and Tallahassee in 1838. He collected plants for Torrey in Florida and Mississippi.

John Loomis Blodgett was born at South Amherst, Mass., in 1809, studied medicine at Pittsfield and spent fifteen years at Key West as physician and druggist.

He was the first to collect extensively on the lower Florida Keys.

A new era was now reached in American botany when men specialized in the subject instead of treating it merely as a side line. Asa Gray was the leader in this period. Born at Sauquoit, New York, in 1810, he first took up medicine but soon changed to botany, studying under Torrey in New York. From 1842 to 1888 he was Professor of Natural History at Harvard and Director of the Botanical Garden there from 1864 to 1873, and his large collection was given to Harvard. He had the honor

of succeeding Louis Agassiz as Regent of the Smithsonian Institution.

Alphonso Wood was born in N. H. in 1810, graduated at Dartmouth in 1834 and after teaching at various places settled in West Farms, N. Y., in 1867 to devote his time to botany until his death in 1881. His "Class-Book of Botany," published in 1845, was largely used in the seventies. It is the work of a true field botanist who tried to make his readers think of plants as living things rather than dried specimens. His herbarium was given to the College of Pharmacy in N. Y. It contains his collections made on the Pacific Coast, in the mountains of Ky. and Tenn. and else-

where; also his duplicate sets of mosses and sedges.

Hooker's great work on the flora of British North America, issued in parts from 1829 to 1840, was the last important contribution of a European to the literature of North American botany, at least so far as flowering plants were concerned. was due chiefly to Torrey and Gray, who did better work and were soon recognized as leaders. Gray went to Europe and studied the type material in the old herbaria. In 1838 their joint flora of North America was begun, which superseded those of Michaux, Pursh and Nuttall. This work, however, was never completed because so much new material poured in from the West.

Gray monopolized the general field of taxonomy in the higher plants except for

Alphonso Wood. In special fields there were several men whom Gray could not dominate, such as M. S. Bebb, who studied the willows, and George Thurber and George Vasey, who specialized on the grasses. Chapman, however, followed Gray

without question.

Dr. Alvin Wentworth Chapman was born in 1809 at Southampton, Mass., and graduated at Amherst College in 1830. In 1835 he became a resident of Florida. first at Quincy, then at Marianna, and from 1847 until his sudden death in 1899 at Apalachicola. He possessed great physical and mental energy. His acquaintance with Mr. Stephen Croom, a wealthy planter interested in botany, inspired him to devote his leisure hours to the study of plants. Collections were sent to Torrey and Gray for identification and description. His "Flora of the Southern United States" filled a real need and was well received, running through several editions after its first appearance in 1860. For a good description of Dr. Chapman as a man, see an article by Winifred Kimball in the Journal of the N. Y. Botanical Garden for January, 1921.

uary, 1921.

Hardy Bryan Croom was born in Lenoir Co., N. C., and graduated at the University of North Carolina in 1817. About 1832 he rented a plantation near Aspalaga, Fla., on the Apalachicola River and became quite famous through his discovery of Torreya and Croomia. Torrey and Gray, as well as Chapman, were his friends. While at the threshold of a botanical career he perished in a shipwreck south of Hatteras in 1837 with all his family. A monument to his memory stands in front of

the Episcopal Church at Tallahassee.

During political upheavals in Europe in the thirtys and fortys many immigrants came to this country who exercised considerable influence on the development of botany. One of these was Dr. George Engelmann, a pioneer in the Mississippi Valley, who established a botanical center at St. Louis which was to have a great future. Another was Dr. Leo Lesquereux, from Switzerland, who became famous

for his work on fossil plants and mosses.

Charles Theodore Mohr, born in Germany in 1824, spent seven months in 1846 collecting plants in Surinam and arrived in the United States in 1848. Mobile, Ala., was his home for over forty years after settling there as a pharmacist in 1857. His greatest work was the "Plant Life of Alabama." His private herbarium went to the U. S. National Museum. The Charles Mohr Herbarium, built up under his guidance, remained with the Alabama Geological Survey. His death occurred in 1901. Another immigrant of this period from Germany was Dr. A. Gattinger, of

Nashville, who did notable botanical work in Tennessee.

The division of botanists into "closet botanists" and "field botanists" is not without some foundation, although the true botanist is both. Among the best-known field workers in early North American botany were such men as Short, of Kentucky, famous for the excellency of his distributed specimens; Parry, in the West; Bolander and Bridges, in California; and Charles Wright, perhaps the prince of them all. He was born in Wethersfield, Conn., in 1811, graduated at Yale in 1835 and devoted nearly thirty years to plant collecting. After spending some time in the Southwest he joined the North Pacific Exploring Expedition and later spent over ten years, 1856–67, in Cuba. He died in Connecticut in 1885.

John Donnell Smith, born in Baltimore in 1829, graduated at Yale, studied law

John Donnell Smith, born in Baltimore in 1829, graduated at Yale, studied law and became a captain in the Confederate Army. He spent seven years in Central America making collections of plants. He also collected repeatedly in central Florida during 1877 and the years following. In 1878 he explored the Caloosa-

hatchee River with C. F. Austin, the bryologist.

James G. Cooper was born in N. Y. City in 1930. Most of his botanical work was with western plants but in 1859 he explored the entire east coast of Florida, collecting plants and birds. He died in California in 1902.

#### EARLY WORK IN TROPICAL AMERICA

American tropical plants were studied before those of temperate climes because the earliest explorations were made in tropical regions and the earliest settlements were there. However, south of the United States most of the botanical work has been done by Europeans, even up to recent times. As early as 1526 Oviedo published a small book containing a chapter on the plant products of the islands and mainland of the new country. Monardes followed in 1569 with his "Historia Medicinal," describing plant products and their medicinal properties, which was so popular that fifteen edition were sold in the next half century. The mint genus, Monarda, was dedicated to the author of this work.

Hernandez began his publications on the plants of Mexico in 1615. The medicinal products of Brazil were described in 1648 by Piso and Marcgrav, who were more scientific than either Monardes or Hernandez. The botanical history of the West Indies began with Charles Plumier, a French Franciscan friar who made three voyages to the French islands during the last part of the seventeenth century and published several books on their flora illustrated with hundreds of original drawings. Sir Hans Sloane was in the meantime publishing his flora of Jamaica, followed twenty-five years later by the work of Patrick Browne on the same island and by that

of Hughes on Barbados.

The latter half of the eighteenth century was a period of great activity in the field of tropical American botany. Nikolaus Joseph Jacquin explored the West Indies and the northern coast of South America from 1755 to 1759 on a commission from the Austrian Emperor. While Professor of Botany at the University of Vienna he published the results of his explorations in thirty folio and quarto volumes illustrated with three thousand colored plates. This superb work was followed by one on French Guiana plants by Aublet, on the flora of Chile by Molina and that of Peru by Ruiz and Pavon, based on the unacknowledged studies of Dombey. Vahl also published several works on American plants sent him by various friends, while Olof Swartz published his illustrated flora of the West Indies, 1797–1806. About the close of the century Humboldt and Bonpland began their famous journey of scientific exploration in tropical America, the botanical results of which alone filled fifteen folio and quarto volumes.

During the nineteenth century and the first part of the twentieth numerous European botanists contributed to our knowledge of tropical American plants. Martius published his great work on the flora of Brazil; Karsten and Jameson studied the plants of Ecuador and Colombia; the flora of the Guianas was described by Meyer, Splitgerber, Schomburgk, Miquel and Pulle; that of Cuba by Ramon de la Sagra; of the British West Indies by Grisebach, and of the Antilles by Urban. Mexico and Central America attracted many botanists, notably men like Bentham, Hemsley, Seemann, Martens, Galeotti, Liebman, Oersted and Bateman, the last well known for his handsome work on orchids. The above brief sketch explains why American students of tropical plants, including those of southern Florida, have had to spend much time poring over the old collections preserved in London, Paris,

Berlin and elsewhere in Europe.

#### CHAPTER III

#### FLORIDA PLANTS NAMED FOR BOTANISTS

The list of persons who have collected plants in Florida is a long one and it would be difficult to make it complete. Those who came first were interested in food plants and plants having medicinal value. Later the collectors sought ornamentals for European gardens, and still later novelties for scientific study. Flowering plants naturally received first attention, but few cryptogamic students of North American botany of the past half century have failed to visit Florida at least once. Most of them have made the mistake of collecting here in the winter, when it is dry and cool. instead of during the warmer months. Certain plant groups, however, like woody fungi and mosses, can be studied during the cooler weather.

The geographical position of Florida is quite unique. In the northern part there are many plants common to the eastern United States, some of them ranging westward along the Gulf coast as far as Texas. The southern tip is tropical and most of its plants either occur, or have near relatives, in the West Indies and South America. Throughout the state there are also many endemic species. The Latin names of plants are often dedicated to botanists or plant collectors. Some Florida plants dedicated to workers on American plants are given below, beginning with the

genera and including a short list of species.

Not so long ago several kinds of specific names were capitalized but under the lead of the entomologists the practice was gradually abandoned. Now, even personal names are decapitalized, which I think is a mistake. It is unnecessary, undignified,

devitalizing, and defeats the very purpose of the author in bestowing the name. If one received a letter with his name decapitalized he would be insulted, and justly so. Soon some simpleton will be proposing that the name of God be written in small letters.

Afzelia, dedicated to Adam Afzelius, a professor at Upsala, Sweden.

Amsonia, named for Charles Amson, of South Carolina.

Bartonia, dedicated to Prof. Benjamin S. Barton, of Philadelphia.

Berlandiera, named in honor of J. L. Berlandier, a Swiss botanical collector in Texas and Mexico.

Boltonia, dedicated to James Bolton, an English botanist of the eighteenth century. Bradburya, named for John Bradbury, who traveled in America early in the ninetennth century

Burmannia, named for Johann Burmann, a Dutch botanist of the eighteenth century. Chapmannia, dedicated to Dr. A. W. Chapman, the famous Florida botanist.

Croomia, named in honor of H. B. Croom, who discovered it. Cuthbertia, dedicated to A. Cuthbert of Augusta, Georgia. Doellingeria, named for Th. Doellinger, a botanical explorer. Forestiera, dedicated to Charles Le Forestier, a French physician. Froelichia, named in honor of J. A. Froelich, a German botanist.

Gaillardia, named for M. Gaillard, a French botanist.

Gerberia, named for Dr. Abram P. Garber, who collected it in southern Florida. Gaylussacia, dedicated to Gay-Lussac, the famous chemist. Gilia, named in honor of Philip Gil, a Spanish botanist. Gleditsia, dedicated to J. T. Gleditsch, a German botanist.

Gordonia, named for James Gordon, a London nurseryman.

Halesia, named in honor of Stephen Hales, a distinguished English scientist of the eighteenth century.

Hartmannia, named for Emanuel Hartmann, of Louisiana.

Houstonia, dedicated to Dr. William Houston, a botanist of South America in the eighteenth century.

Jussiaea, named for Bernard de Jussieu, founder of the natural system of plant classification.

Kalmia, named for Peter Kalm, a Swede, who collected plants in North America about the middle of the eighteenth century.

Kneiffia, named for Prof. C. Kneiff, a cryptogamic botanist of Strassburg.

Koellia, dedicated to J. L. Koelle, a German botanist of the eighteenth century. Krameria, named for Johann Kramer, an Austrian physician of the eighteenth century.

Lechea, named for John Leche, a Swedish botanist. Leitneria, dedicated to Dr. E. F. Leitner, a German naturalist who was killed in Florida during the Seminole war.

Lobelia, named for Matthias L'Obel, an early Flemish botanist.

Ludwigia, dedicated to C. G. Ludwig, Professor of Botany at Leipzig.

Magnolia, named for Pierre Magnol, Professor of Botany in Montpellier in the seventeenth century.

Marshallia, named for Humphry Marshall, of Pennsylvania.

Meibomia, dedicated to Dr. Brandus Meibom, who died at Helmstadt in 1740.

Mitchella, named in honor of Dr. John Mitchell, a Virginia botanist of the eighteenth century.

Morongia, named for Rev. Thomas Morong, who contributed to the first edition of Britton and Brown's Flora.

Muhlenbergia, a genus of grasses dedicated to Rev. Henry Muhlenberg, of Pennsylvania.

Planera, named for Johann Planer, Professor of Botany in Erfurt in the eighteenth century.

Pluchea, dedicated to Abbé N. A. Pluche, of Paris.

Poinsettia, named for Joel Roberts Poinsette, of South Carolina, who brought it from Mexico.

Rudbeckia, dedicated to Claus Rudbeck, a Swedish botanist of the seventeenth

Ruellia, named for Ruel, an early French herbalist.

Sarracenia, dedicated to Dr. Jean Sarracin, a Quebec botanist. Stillingia, named for Dr. B. Stillingfleet, an English botanist.

Stuartia, named in honor of John Stuart, Marquis of Bute. Often spelled *Stewartia*. Torreya, dedicated to Dr. John Torrey, of New York. Displaced by *Tumnion*. Tradescantia, named for John Tradescant, gardener to Charles I. Vernonia, named in honor of William Vernon, an English botanist.

Warea, dedicated to Nathaniel Ware, who collected plants in Florida early in the nineteenth century.

#### SPECIFIC PERSONAL NAMES

Asclepias Michauxii, dedicated to André Michaux, a French botanist who worked on North American trees, etc.

Aster Mohrii, dedicated to Charles Mohr, an Alabama botanist of note.

Chamaesyce Blodgettii, named for John L. Blodgett, who collected many plants in Florida about a century ago.

Cirsium Nuttallii, dedicated to Thomas Nuttall, who collected widely in the United States early in the nineteenth century.

Cirsium Smallii, named for Dr. John K. Small, who collected it. Coreopsis Leavenworthii, named for Dr. M. C. Leavenworth.

Crotalaria Purshii, dedicated to Frederick Pursh, who collected widely in America early in the nineteenth century.

Croton Engelmannii, named for Dr. George Engelmann, the St. Louis botanist. Eryngium Baldwinii, named for William Baldwin, who collected plants in Florida in 1779.

Galactia Elliottii, dedicated to Stephen Elliott, a distinguished botanist of South Carolina.

Ilex Curtissii, dedicated to Allen H. Curtiss, who lived in Jacksonville and collected

many plants in Florida.

Lilium Catesbeyi, dedicated to Mark Catesby, a famous naturalist of the early eighteenth century who collected plants in Florida.

Magnolia Ashei, named for William W. Ashe, of North Carolina, who discovered it. Panicum Ravenelii, named for Henry W. Ravenel, the famous collector of fungi. Paspalum Boscianum, named for Louis A. Bosc, an early writer on Carolina fungi. Phlox Drummondii, named for Thomas Drummond, who discovered it in Texas. Rhexia Nashii, named for George V. Nash, of New York, who discovered it in Florida. Rynchospora Rappiana, named for Severin Rapp, long a resident of Sanford, Fla.

Sabbatia Harperi, named for Dr. R. M. Harper, who collected it. Sambucus Simpsonii, named for Charles T. Simpson, long a resident of Florida. Smilax Walteri, named for Thomas Walter, the famous South Carolina botanist. Solidago Edisoniana, dedicated to Thomas Edison, who used goldenrod in his rubber experiments.

#### CHAPTER IV

#### MODERN AMERICAN BOTANY

The establishment of state agricultural colleges and experiment stations was a great stimulus to all phases of botany in the United States. Then came the Spanish-American War, which opened up tropical lands, both in the West Indies and the Orient, with their opportunities and responsibilities. The list of men who entered the botanical field at this time is a long one. I knew most of them. The following were taxonomists of flowering plants, placed in alphabetical order for greater convenience.

Edward Johnston Alexander was born at Asheville, N. C., in 1901 and worked on the taxonomy of flowering plants at the New York Botanical Garden from 1926 to date, contributing the text for several genera in Small's "Manual."

Oakes Ames was born at North Easton, Mass., in 1874, received the A.M. degree at Harvard in 1899 and taught botany there from that time to date. He specialized on orchids.

William Willard Ashe was born in Raleigh, N. C., in 1872, received the A.B. degree at the University of North Carolina in 1891 and M.S. at Cornell in 1892. In 1902 he became connected with the North Carolina Geological Survey and later with the state and national forest services. His knowledge of the trees of the south-

eastern states was outstanding.

Liberty Hyde Bailey was born at South Haven, Mich., in 1858, received the M.S. degree at the Michigan Agricultural College in 1885 and was Professor of Horticulture there from 1884 to 1888, when he was elected to the same position at Cornell. His distinguished career in horticulture is well known. His visits to Florida, however, have been connected with taxonomic studies in such plant groups as the blackberries and palms.

Mary Francis Baker, born Mary Evans Francis at Plainfield, Conn., in 1876, moved to Florida in 1917. The following year she married Thomas R. Baker, Ph.D., of Winter Park, who was for many years a college professor of natural science in Pennsylvania and Florida. In 1912 Mrs. Baker published a book on grasses. Her work on "Florida Wild Flowers" appeared in 1926 with a revised edition in 1938. This book has done much to popularize the study of botany in the state. Her herbarium and scientific books were given to Rollins College shortly before her death.

Carleton Roy Ball was born in Ia. in 1873, received the M.S. degree at Iowa College in 1899 and entered the U.S. D. A. the same year. He was a specialist on

the taxonomy of grasses and willows.

John Hendley Barnhart was born in Brooklyn, N. Y., in 1871, received the A.M. degree at Wesleyan in 1893 and M.D. at Columbia in 1896. In 1903 he joined the staff of the New York Botanical Garden, devoting his time mainly to bibliography, biography, nomenclature and editorial work. He helped formulate the International Code of Botanical Nomenclature, attending the congresses at Vienna, Brussels and Cambridge. In working on the taxonomy of the bladderwort family he handled a number of Florida plants.

Chauncey Delos Beadle was born at St. Catharines, Ont., in 1866 and attended the Ontario Agricultural College and Cornell University. In 1890 he became Director of the Biltmore Herbarium and devoted many years to the study of southern plants. He described many species of hawthorns, a number of them from Florida,

and had a living collection of hawthorn trees grown mostly from seeds.

Charles Edwin Bessey was born at Milton, O., in 1845, received the Ph.D. degree at Iowa in 1879 and was Professor of Botany at Iowa State and later at Nebraska. He was a great teacher and trained many splendid men for teaching

and research positions.

Eugene Pintard Bicknell was born at Riverdale-on-Hudson, N. Y., in 1859 and died at his home on Long Island in 1925, having been a member of the Torrey Botanical Club for forty-five years, during which time he contributed fifty-seven articles to the Torrey Bulletin. His herbarium was donated to the New York Botanical Garden by his widow. It contains several specimens of Florida plants, especially those belonging to the genus Sisvrinchium.

Sidney Fay Blake was born in Mass. in 1892, received the Ph.D. degree at Harvard in 1917 and the same year entered the U. S. D. A., specializing on the

compositae and polygalaceae.

Ezra Brainerd died at Middlebury, Vt., in 1924 at the advanced age of eighty. He taught at Middlebury College and served as its president for over twenty years. In 1895 he helped to organize the Vermont Botanical Club. His "Violets of North America," published in 1921, is an outstanding work. Several of the species he

collected in Florida and grew in his experimental garden.

Nathaniel Lord Britton was born on Staten Island, N. Y., in 1859 and died at his home in Bedford Park in 1934. In 1881 he received the degree of Ph.D. at Columbia, his thesis being a catalog of New Jersey plants. For ten years he edited the Torrey Bulletin, and in 1896-98 his splendid illustrated flora appeared in three volumes. Elected Director of the New York Botanical Garden in 1896, he devoted himself untiringly to the development of this great institution for the remainder of his life. He and Dr. Underwood drew up the preliminary plans for "North American Flora" as early as 1901, the year of his first visit to the West Indies, which was followed by about thirty more in succeeding years. He was the moving spirit in a scientific survey of Puerto Rico and later extended the explorations of the Garden to include northern South America. One of his finest publications, with the assistance of Dr. J. N. Rose, was an illustrated work on the cacti, published in four volumes in 1919-23. His devotion was first of all to his own botanical studies and secondly to his only "child," the Garden.

Edward Sanford Burgess was born in Little Valley, N. Y., in 1855, received the A.B. degree at Hamilton College in 1879 and Ph.D. at Columbia in 1899. He was Professor of Natural Science at Hunter College, in New York City, from 1895 to 1925. His special study was the asters.

Mrs. Agnes Chase was born in Ill. in 1869 and worked on grasses for the U.S.

D. A. from 1903 until her death in 1940.

Victor King Chestnut was born in Calif. in 1867, received the B.S. degree at California in 1890 and worked on poisonous plants and drug plants for the U.S.D.A. until his retirement in 1933. We have a number of poisonous plants in Florida that are dangerous to stock, such as yellow jessamine, Jimson weed, oleander, clippings from wild cherry and laurel cherry, dwarf poinciana seed, Crotalaria spectabilis, and several others.

Allen Hiram Curtiss was born at Central Square, N. Y., in 1845 and received a high school education. In 1875 he became associated with the U.S. Department of Agriculture as collecting botanist and settled in Jacksonville, Fla., where he remained until his death in 1907. Large plant collections were made by him and distributed

Charles Clemon Deam was born at Bluffton, Ind., in 1865 and was state forester of Indiana from 1909 to 1928, when he became research forester. He published an

excellent book on the flora of Indiana.

Lyster Hoxie Dewey was born in Mich. in 1865, received the A.B. degree at Michigan State in 1888 and worked on fibers for the U. S. D. A. from 1890 to 1935,

when he retired. He also specialized on grasses and weeds.

Willard Webster Eggleston was born at Pittsfield, Vermont, in 1863 and received the B.S. degree at Dartmouth College in 1891. He worked at the New York Botanical Garden from 1904 to 1907 and in 1910 became connected with the U.S. Department of Agriculture in Washington. He devoted considerable time to the study of hawthorns and collected many specimens of them in Florida.

Norman Carter Fassett was born in Mass. in 1900, received the Ph.D. degree at Harvard in 1925 and taught botany at Wisconsin from that time to date. He published in 1940 "A Manual of Aquatic Plants," which is very helpful because so

fully illustrated.

Henry Allan Gleason was born at Dalton City, Ill., in 1882, received the A.M. degree at Illinois in 1904, and Ph.D. at Columbia in 1906. From 1901 to 1910 he taught at Illinois University, from 1910 to 1919 at Michigan, and joined the Staff of the New York Botanical Garden in 1919. He has specialized on plant ecology and the flora of northern South America.

Edward Lee Greene was born in R. I. in 1843 and became associate botanist at

the U. S. National Museum in 1904.

Abram Paschall Garber was born in 1838 at Columbia, Pa., graduated at Lafavette College in 1868 and received the M.D. degree at the University of Pennsylvania in 1872. About 1877 he went to southern Florida for his health and spent some time in plant collecting. In 1880 he botanized in Puerto Rico.

Albert Spear Hitchcock was born in Owosso, Mich., in 1865, received the M.S. degree at Iowa State College in 1886 and was botanical assistant at the Missouri Botanical Garden in 1889-91. He began his special work on grasses with the U.S. Department of Agriculture in 1901 and distinguished himself as a taxonomist in this difficult group. His book on grasses is a standard text. Before his death in 1935 he had prepared a treatment of the grasses of the southeastern United States for Small's "Manual."

Homer Doliver House was born near Oneida, N. Y., in 1878, received the B.S. degree at Syracuse University in 1902 and Ph.D. at Columbia in 1908. After teaching at Clemson College and the Biltmore School of Forestry for a number of years he became State Botanist of New York, with headquarters at Albany, and prepared a handsome illustrated work on the wild flowers of New York state. This book has been very popular in the eastern United States and many Floridians have a copy of it. Some day a similar work will deal exclusively with Florida wild flowers. Perhaps it will be sponsored by a Florida Botanical Club similar to the Torrey Botanical

Otto Kuntze was born at Leipzig in 1843 and at an early age published a pocket flora of the vicinity. Becoming wealthy, he retired from business to travel and study plants. His "Revisio Genera Plantarum" is a large work in which he proposes to change 25,000 scientific names long in use. After living many years in Berlin he died in Italy in 1907. His plant collection of 30,000 specimens is at the N. Y. Botanical Garden.

Kenneth Kent Mackenzie was born in Brooklyn, N. Y., in 1877 and died in 1924.

He contributed Carex and Solidago to Small's "Manual" and prepared a handsomely

illustrated work on Carex.

Elmer Drew Merrill was born in Me. in 1876, received the M.S. degree at Maine in 1904 and became botanist at Manila from 1902 to 1919. He was in California from 1924 to 1929, was Director of the New York Botanical Garden 1930–35, then became Professor of Botany at Harvard and Supervisor of the Arnold Arboretum. He described thousands of new species of flowering plants from China, the

Philippines and neighboring islands.

Charles Frederick Millspaugh was born at Ithaca, N. Y., in 1854, attended Cornell from 1872 to 1875 and was Professor of Botany at West Virginia from 1891 to 1892, during which time he worked on a list of the fungi of the state. His chief work, however, was begun in 1894 when he became Curator in Botany at the Field Columbian Museum, Chicago. He studied the economic plants of the American Indians, the flora of tropical America and the Euphorbiaceae of North America. In his work on the flora of the Bahamas he studied many species that occur also in southern

Harold Norman Moldenke was born in N. J. in 1909, received the Ph.D. degree at Columbia in 1934 and worked on the taxonomy of flowering plants at the New York Botanical Garden from 1932 to date. He collected extensively in Florida.

One of his specialties was Bible Plants.

Walter Muenscher was born at Fischback, Germany, in 1891, received the Ph.D. degree at Cornell in 1921 and taught botany there from 1916 to date. He worked on slime molds, algae and weed control. His book on "Weeds" appeared in 1936.

George Valentine Nash was born in Brooklyn, N. Y., in 1864 and died in 1921. After studying under Dr. Britton at Columbia he was employed at the Garden as general assistant in 1890 and became flead Gardener in 1901 with Dr. Small to get living plants collected in central Florida and returned in 1901 with Dr. Small to get living plants. He was a specialist in grasses and orchids. When general assistant in 1896 and became Head Gardener in 1901. During 1894-5 he he desired more space for horticultural features in the open I was able with the aid of Francis Lynde Stetson to secure two hundred and fifty acres of land from the City for the purpose. In this additional area three important and attractive plantations were developed, the Rose Garden, Iris Garden and Rock Garden.

Dr. Henry Nehrling was born in Wisc. in 1853. He wrote an interesting book, published in 1933, entitled "The Plant World in Florida."

Ernest Jesse Palmer was born in England in 1875 and after some time spent at the Missouri Botanical Garden became associated with the Arnold Arboretum, where he has worked on plant geography and the taxonomy of hawthorns and other woody plants.

Louis Hermann Pammel was born at LaCrosse, Wisc., in 1862, received the degree of M.S. at Wisconsin in 1889 and Ph.D. at Washington (St. Louis) in 1899. He was Professor of Botany at Iowa State from 1889 until near his death in 1931.

He devoted many years to the study of weeds and poisonous plants.

Francis Whittier Pennell was born at Wawa, Pa., in 1886, received the B.S. degree at the University of Pennsylvania in 1911 and Ph.D. at Columbia in 1913. From 1914 to 1921 he was Assistant Curator at the New York Botanical Garden, then became Curator of Plants at the Philadelphia Academy of Natural Sciences. Monograph 1 of this institution, published in 1935, was his work on "The Scrophulariaceae of Eastern Temperate North America." He also contributed the family to Small's "Manual."

Charles Louis Pollard was born in New York City in 1872, received the degree of A.M. from Columbia in 1894 and was Assistant Curator of Plants in the U.S.

National Museum from 1895 to 1903. He studied the violets.

Alfred Rehder was born in Waldenburg, Saxony, in 1863, received university training in Germany and was connected with the Arnold Arboretum from 1898 to date, specializing in the taxonomy of woody plants.

Benjamin Lincoln Robinson was born in Ill. in 1864, received the Ph.D. degree at Strasburg in 1889 and worked on flowering plants while teaching botany at

Harvard from 1892 to near his death in 1925.

Joseph Nelson Rose was born in Union Co., Ind., in 1862 and received the Ph.D. degree from Wabash in 1889. In 1896 he became a curator in the U. S. National Museum and began his study of the cacti of North America in collaboration with Dr. N. L. Britton. He died in 1928.

Henry Hurd Rusby was born at Franklin, N. J., in 1855, received the M.D. degree at New York University in 1884 and became a professor in the New York

College of Pharmacy in 1888. He explored parts of South America for drug plants and while Honorary Curator of the Economic Museum at the New York Botanical Garden handled a great deal of exhibition material from Florida and tropical America. His descriptive list of the exhibits in this museum is very interesting reading. Two facts stand out in Dr. Rusby's life, as I remember him. He always had an amazing story to tell and was always in trouble.

Per Axel Rydberg was born in Sweden in 1860 and came to America in 1882. The great teacher, Charles E. Bessey, inspired him to be a botanist. He was a curator at the New York Botanical Garden from 1899 until his death in 1931. Although best known for his work on Rocky Mountain plants he studied several groups

of plants well represented in Florida.

Charles Sprague Sargent was born in Boston in 1841, graduated at Harvard in 1862 and then became a soldier. He was Director of the Arnold Arboretum from its establishment in 1872 until his death in 1927. His great work on the Silva of North America is a monument to fifty-five years study of woody plants. He collected in Florida and described several trees and shrubs of the state. His report on the forests of North America led to the establishment of the Bureau of Forestry in Washington.

Dr. Charles Torrey Simpson was born at Tiskilwa, Ill. in 1846 and worked for a short time in the U. S. National Museum. He was interested in the flora of Florida, and the mollusks of Florida and the West Indies. His "Out of Doors in Florida" appeared in 1923 and "Florida Wild Life" in 1932. These books are based on long

years of experience and observation in the state.

John Kunkel Small was born of Pennsylvania-German stock at Harrisburg, Pa., in 1869 and entered Franklin and Marshall College in 1888. A.A. Heller was a classmate of his and together they roamed the woods and fields about Lancaster in search of plants. In 1890 he joined the Torrey Botanical Club, to which he contributed a total of fifty-five papers. During the summer of 1891 he and Heller explored the mountains of western North Carolina, which was the beginning of his lifelong interest in the flora of the southern states. A few months before his graduation in 1892 he published a list of the mosses of Lancaster Co.

The second phase of his botanical education began in 1892, when he was given a fellowship in botany at Columbia University, under N. L. Britton, and moved to New York. For the next three years he curated the Columbia herbarium and earned a doctor's degree. His thesis, a monograph of the North American species of Polygonum, was published in 1895. In 1898 he became Curator of the Museums at the New York Botanical Garden, where he prepared his monumental work on the flora of the southeastern states, a volume of about fourteen hundred pages, pub-

lished in 1903. A revised edition was issued in 1913.

Dr. Small's famous botanical explorations in Florida began in 1901 and were continued for thirty-five years. In 1932 he published the "Ferns of Florida" and in 1933 his "Manual" appeared, which contained descriptions of over 5,500 species on 1,554 pages of text with numerous helpful illustrations. He was a hard and earnest worker. One of his recreations was music. He played the flute expertly and had his children trained as a family orchestra.

Paul Carpenter Standley was born at Avalon, Mo., in 1884, received the M.S. degree at New Mexico College in 1909 and worked in taxonomic botany for the U.S. National Museum from that time until 1928, when he went to the Field Museum in Chicago. His "Flora of the Panama Canal Zone," with 66 halftone plates, appeared

in 1928 as a contribution from the National Museum.

Norman Taylor was born in Birmingham, Eng., in 1883, studied two years at Cornell, worked at the New York Botanical Garden from 1904 to 1911 and then became Curator of plants at the Brooklyn Botanic Garden until 1929. He collected

plants in tropical America and worked on the local flora about N. Y. City.

William Trelease was born at Mt. Vernon, N. Y., in 1857, received the Ph.D. degree at Harvard in 1884, was Professor of Botany at Wisconsin 1883–85 and then at Washington (St. Louis). In 1889 he became Director of the Missouri Botanical Garden, where he built up a large library and herbarium. He was Professor of Botany at the University of Illinois from 1913 to 1936, when he retired. His important publications on oaks and certain desert plants are well known.

Johannes Uphof was born in Amsterdam, Holland, in 1886, received the Ph.D. degree at Amsterdam in 1911 and in 1922 became Professor of Botany at Rollins

College. He worked on cacti, bacteria and genetics.

Erdman West was born at Glenside, Pa., in 1894, received the M.S. degree at

Florida in 1931 and worked on mycology and plant pathology at the Florida Experiment Station from 1925 to date. He not only collected fungi but also built up a good

working collection of flowering plants.

Percy Wilson was born in N. J. in 1879 and worked on the taxonomy of flowering plants at the New York Botanical Garden almost continuously from 1899 to his death. He explored Honduras and the West Indies, and contributed the text on several families to North American Flora.

#### FOSSIL PLANTS

Paleobotany is a fascinating study dealing with plants that lived in past ages and left their records on the rocks. Who has not seen the delicate print frond outlined on a slab of sandstone from a coal mine? In Florida all fossils are comparatively recent but no less important on that account. A few of the men who have worked on fossil botany in America are listed below.

John Strong Newberry was born in Windsor, Conn., in 1822, studied medicine but quit it for geological exploration and was Professor of Geology at Columbia from 1866 until near his death. His publications were many and important and his

collections extensive.

William Morris Fontaine was born in Va. in 1835 and received an A.M. degree

from the University of Virginia in 1859.

Lester Frank Ward was born at Joliet, Ill., in 1841 and was with the U. S. Geological Survey from 1881 to 1905. He specialized on our mesozoic flora.

David Pearce Penhallow, born in 1854, worked on the fossil plants of Canada. Frank Hall Knowlton was born at Brandon, Vt., in 1860 and studied the Cretaceous and Tertiary fossil plants of North America.

Charles David White was born at Palmyra, N. Y., in 1862, received the B.S. degree at Cornell in 1886 and joined the U. S. Geological Survey the same year. One of his special subjects was the flora of the Pottsville formation.

George Reber Wieland was born in Pa. in 1865 and received the Ph.D. degree at Yale in 1900. From 1898 he was engaged in research in the Yale Museum.

Otto Emery Jennings was born at Olena, O., in 1877 and received the B.S. degree at Ohio State in 1903. From 1904 he was botanical curator in the Carnegie Museum at Pittsburg. His specialities were systematic botany, ecology and paleobotany.

Arthur Hollick was born on Staten Island in 1857, entered Columbia in 1875 and became an assistant in geology there in 1892. In 1901 he was appointed Assistant Curator at the New York Botanical Garden in charge of the collection of fossil plants. Explorations in Alaska, the West Indies and elsewhere yielded material for important publications. His death occurred in 1933. Dr. Hollick learned natural history from his father in boyhood and in young manhood was fortunate enough to be associated with such men as Thurber, Leggett, Wood and Newberry.

Edward Wilber Berry was born in Newark, N. J., in 1875 and was connected with Hopkins University, either as student or teacher, from 1905 to date. He devoted much time to the fossil flora of the southeastern United States and South

America.

#### CHAPTER V

#### **CRYPTOGAMS**

The botanists mentioned thus far have studied flowering plants, or phanerogams, reproducing by seeds. Cryptogams are flowerless plants, reproducing by spores. They are divided into three large groups, the Pteridophyta, or ferns and fern allies; the Bryophyta, containing the mosses and liverworts; and the Thallophyta, including the algae and fungi. These will now be treated in the order mentioned, which is just the opposite from that of their development. Nature produced the simple forms first and gradually passed on to those of greater complexity, but the historian must begin where man began, with the study of the complex.

Ferns are so beautiful that they have always attracted students of the higher plants, hence their inclusion in "floras." Most of the older botanists collected ferns along with flowers. Even Linnaeus knew 45 of our American species and named a dozen of our genera. When I began to study the group in 1895 I had Gray's "Manual," Underwood's little book on native ferns and splendid collecting grounds about Staunton and Blacksburg, in Virginia. My discovery of Asplenium ebenoides near Blacksburg in the summer of 1896 led to an article on it in the "Fern Bulletin," which brought about exchanges with collectors all over the country and I soon had specimens of nearly everything available. Then I constructed a fernery and planted many living specimens in it. Dr. Underwood asked me for a complete set of Virginia ferns and he gave me many from Florida in return.

My first sight of D. C. Eaton's splendid work on ferns, placed in my hands by

My first sight of D. C. Eaton's splendid work on ferns, placed in my hands by Dr. Rose on a visit to Washington, will never be forgotten. Soon, however, I had for my own the first volume of Britton & Brown's "Illustrated Flora" with its treatment of ferns and their allies by Underwood; and when the second edition came out in 1913 with a revision by Maxon I got that too. By this time Mr. Maxon had turned his attention to species found in tropical America and was publishing many new species and valuable notes on critical species in a series of contributions from the U. S. National Herbarium, begun in 1908 and running through several years.

When I came to Florida most of the ferns in the northern counties were quite familiar to me. Chapman's "Flora" gave fair descriptions of those not listed in my other books. But exactly the book I needed appeared in 1931. It was Small's little volume on Florida ferns with every known species described and many of them illustrated. About the middle of the nineteenth century only 50 wild ferns were known in the state but this book contained 107 species. In 1938 Small's larger illustrated work on the ferns of the southeastern states appeared, which was practically the "last word" on the subject for the region covered.

The older botanists included ferns in their floras of tropical America. Not until I roamed through the high mountains of Jamaica did I realize the wealth of fern material Olof Swartz had at his command. Once, near the summit of Sir John Peak, I could find nothing to tie my pony to except a gorgeous tree fern. It seemed a sacrilege. In Cuba, Mexico, Guiana, Brazil, wherever I went, it was the same story,

a wealth of luxurious ferns with the finest foliage in all the world.

In 1908 the fern collection at the New York Botanical Garden was christened the "Underwood Fern Herbarium," and justly so, because its 16,000 specimens had been brought together largely through Dr. Underwood's efforts; with material from South America secured by H. H. Smith, Miguel Bang, H. H. Rusby, R. S. Williams

and others.

Lucien Marcus Underwood was born at New Woodstock, N. Y., in 1853, received the Ph.D. degree at Syracuse in 1879 and taught botany at Syracuse, DePauw and the Alabama Polytechnic Institute before coming to Columbia in 1896. Primarily an excellent teacher, he specialized on ferns but also knew a great deal about other plant groups. His collection of fungi, containing 17,000 specimens, was purchased by the New York Botanical Garden in 1914. I collected ferns for Dr. Underwood in Virginia several years before I met him. He was responsible for my first articles on polypores and very probably for my position at the Garden. Countless friends mourned his tragic and untimely death in 1907.

Willard Nelson Clute was born in 1869 at Painted Post, N. Y., and was herbarium assistant at Columbia University and the New York Botanical Garden from 1896 to 1899. He was much interested in ferns and was both publisher and editor of the "Fern Bulletin." In 1901 he began the publication of the "American Botanist." The second edition of his "Our Ferns" appeared in 1938. He also published

"Fern Allies," with 288 pp. and 155 illustrations.

William Ralph Maxon was born in Oneida, N. Y., in 1877, received the degree of Ph.B. at Syracuse in 1898 and joined the staff of the U. S. National Museum the following year. He specialized on the taxonomy of ferns, especially those of tropical

America.

Other students of American ferns and their allies were G. E. Davenport, D. C. Eaton, A. A. Eaton, W. A. Knight, Ralph Benedict, the St. John Brothers, and those mentioned in the following publications:

American Fern Journal—1910 to date. Broun, Maurice—"Index to N. A. Ferns," 1938. Brown, Clair A. and Correll, D. S.—"Ferns of Louisiana," 1941. Christensen, Carl—"Index Filicum," 1905–34. Frye, T. C.—"Ferns of the Northwest," 1934. Hooker, W. J.—"Filices Exoticae," 1859. North American Flora 16: 1–88. 1909. Parsons, Frances T.—"How to Know the Ferns," 1925. Slosson, Margaret—"How Ferns Grow," 1906. Waters, C. E.—"Ferns," 1908. Wherry, E. T.—"Guide to Eastern Ferns," 1937. Wiley, Farida A.—"Ferns of the Northeastern U. S.," 1936.

Many American geologists have been fascinated with the past history of our fern-plants as recorded in the rocks. Much of our coal originated in forests of giant horsetails, lycopods, and other fern ancestors. Cultivators of ferns praise their delicate beauty; orchid growers use Osmunda fiber in their hanging baskets; and during the Christmas season great quantities of woodland species are harvested for decoration. No wonder the ferns are admired and loved.

#### MOSSES

Mosses are related to ferns but have no prothallium and no true vascular bundles. The protonema develops from the spore and upon it a bud arises which grows into the moss plant, which bears the sporophyte, consisting of stalk and capsule. In collecting mosses one should always get ripe capsules if possible since they contain valuable characters for identification. Because of their small size mosses are easily collected, pressed and preserved. Fossil mosses are rare, owing to their herbaceous character. Beginners should distinguish the true mosses from "sea mosses," which are algae; "reindeer moss," which is a lichen; and "Spanish moss,

which is a flowering plant related to the pineapple.

While collecting ferns in the mountains of Virginia I became interested in the mosses and this interest grew at Cornell as I watched the work of Durand. In New York I found a fine collection and library, with experts like Mrs. Britton, Williams, Small and Grout. On coming to Florida I found no collection but an abundance of material awaiting collection and study. As soon as I could get this material identified I sent a dozen sets of it to the principal moss students in the country asking for exchanges, just as I did with the ferns in Virginia, and received generous sets of excellent material. One of these sets came from central Florida, prepared by James B. McFarlin, who published a list of mosses from Polk Co. At Rapp's death the Florida Experiment Station received his large moss collection.

When I visited Linné's "Hammarby," near Upsala, I found the woods full of mosses. Indeed, Linnaeus named many of the species found in America. In Sweden the walls are often stuffed with mosses to keep out the cold, while peat is used pretty generally in Europe for fuel. Among the moss students of Europe one finds such names as Hedwig, Mueller, Schimper, Lindley, Bridel, Hooker, Nees and Brotherus, who prepared the part on mosses for Engler & Prantl's great work.

few of our American workers are given below.

William Starling Sullivant was born in Ohio in 1803, graduated at Yale in 1823 and in 1843 collected mosses in the mountains from Md. to Ga. His "Musci Alleghanienses," in two volumes, appeared in 1845, his "Musci Cubenses" in 1861. "Icones Muscoruum," with 129 handsome copper plates, was published in 1864. Coe Austin owed him much, as did Lesquereux. After laying a good foundation for bryology in America he died at Columbus in 1873. All his moss books and collec-

tions went to Harvard.

Leo Lesquereux was born in Switzerland in 1806 and attracted the attention of Louis Agassiz, then teaching at Neuchâtel, by some papers he published on mosses. In 1844 he won a government prize for a peat-bog essay and was employed to manage bogs. Coming to Boston in 1848, he at once contacted Agassiz but a few months later moved to Columbus, O., and became Sullivant's assistant. The following year he explored our southern mountains for mosses and the two men sent out sets of exsiccati. He helped Sullivant with his "Icones Muscorum." Thomas P. James, of Cambridge, Mass., assisted with the microscopic work on Lesquereux' "Manual of Mosses." The death of the author occurred at Columbus in 1889.

Dr. George Newton Best was born at Round Valley, N. J., in 1846, received an M.D. degree at Pennsylvania in 1875 and was a student of mosses until his death in

1926. He was a frequent visitor at the New York Botanical Garden.

Elizabeth Gertrude Britton was born in New York in 1858 and died there in 1934. Her childhood was partly spent in Cuba, where she learned to speak Spanish, a distinct asset later in West Indian exploration. In 1885 she married N. L. Britton, then an assistant in Geology at Columbia, and specialized on mosses. In 1902 she helped to organize The Wild Flower Preservation Society of America and became active in its promotion. Appointed Honorary Curator of Mosses at the Garden in 1912, she devoted herself to curating the large collection, with the help of Mr. Williams, and to writing notes and short articles for various periodicals.

Theodore Christian Frye was born in Washington, Ill., in 1869, received the Ph.D. degree at Chicago in 1902, and was Professor of Botany at Washington (Seattle) from 1903 to date. He specialized on the taxonomy of western mosses and

marine algae.

Elias Judah Durand was born at Canandaigua, N. Y., in 1870, received the Sc.D. degree at Cornell in 1895 and taught botany at Cornell, Missouri and Minne-

He worked on mosses, liverworts, discomycetes and myxomycetes.

Abel Joel Grout was born in Newfane, Vt., in 1867, graduated at Vermont, and in 1897 received the Ph.D. degree at Columbia. For 37 years he taught biology, mostly in N. Y. City high schools, while studying mosses. For ten years he was on Mosses at the New York Botanical Garden. He did more than anyone else in America to popularize the study of mosses. His book on "Mosses With a Hand-lens" filled a real need, and his eight years as editor of "The Bryologist" placed that periodical on a firm footing. His "Moss Flora of North America" is all that the most critical student of our mosses needs in the way of descriptions and figures. It was begun in 1928 and completed in three large volumes in 1940. For many years Dr. Grout spent his winters at Manatee, Fla.
Albert LeRoy Andrews was born at Williamstown, Mass., in 1878, received the

A.M. degree at Harvard in 1903 and Ph.D. at Kiel in 1908. He taught botany at Cornell from 1909 to date and contributed the Sphagnaceae to Vol. 15, part I, of "North American Flora," published in 1913. Part 2 of this volume, published the same year, was contributed by Robert S. Williams.

Lewis Edward Anderson was born in Miss. in 1912, received the Ph.D. degree at Pennsylvania in 1936 and taught botany at Duke. He specialized on the bryo-

phytes of North Carolina.

William Mitten was a native of Sussex, Eng., and published a list of mosses found about his home in 1851. For sixty years he studied mosses from all parts of the world. Shortly after his death in 1906 I visited his daughter Flora to arrange for the purchase of his great collection, which is now at the New York Botanical Garden. It contains collections made in North America by Drummond, Richardson, Lyall, Macoun, Short, Torrey, Chapman and others. His greatest work, "Musci Austro-Americani," containing descriptions of over 600 new species, was based on collections made in tropical America by Spruce, Jameson, Lindig, Weir, Glaziou, Fendler, Swartz, Wright and numerous others.

In 1934 the moss herbarium of the Garden contained 173,000 mounted specimens and thousands of duplicates. Besides the Mitten collection there were the collections of August Jaeger, G. N. Best, E. A. Rau and many others, with the exsiccati of Austin, Drummond, Sullivant, Holzinger, Bauer, and Grout; also more recent collections obtained in tropical America by C. G. Pringle, Jared G. Smith, R. S. Williams, W. R. Maxon, Percy Wilson and other members of the Garden Staff.

#### Some Moss Literature

The Bryologist "Bryologia Europea" Barnes & Heald's "Keys" Barnes' "Revision of Fissidens" Campbell's "Mosses and Ferns" Dixon & Jameson's "Handbook of British Mosses" Engler & Prantl's "Pflanzenfamilien" Grout's "Mosses With a Hand-lens and Microscope" Grout's "Mosses Will a Handrichs and Microscope Grout's "Moss Flora of North America"
Lesquereux & James' "Manual of the Mosses of N. A.'
Macoun's "Canadian Plants, Part VI"
"North American Flora" 15: parts I & 2, 1913
Sullivant's "Icones Muscorum" and "Supplement"

#### LIVERWORTS

Liverworts are closely related to mosses and have largely been collected and studied in connection with them. Botanists of the nineties will recall some figures of liverworts at the back of Gray's "Manual." Dr. M. A. Howe studied this group while still in California and he curated the collection at the New York Botanical Garden, with the help of Miss Caroline C. Haynes, who purchased his collection in 1909 and afterwards presented it to the Garden. There were in it nearly 2,000 packets of specimens, the basis of Dr. Howe's publication on California liverworts in 1899. Dr. Evans arranged the liverworts of the Mitten Collection for the Garden herbarium and also named specimens collected by members of the Garden Staff.

Alexander William Evans was born in Buffalo, N. Y., in 1868, received the Ph.D. degree at Yale in 1899 and has taught botany at Yale since. He is our American expert on the Hepaticae, having contributed a large part of Vol. 14, part 1, of "North American Flora," which appeared in 1923. The Ricciaceae in this part were con-American Flora," which tributed by Dr. Howe.

William Land was born in Ind. in 1865, received the Ph.D. degree at Chicago in 1904 and taught there from that time until 1931, when he retired. He studied

the morphology of the liverworts, especially the tropical species.

Little special work has been done on this group in Florida. Many collections have been made by outside botanists but northern herbaria must be visited in order to see them. Underwood got many in Florida while collecting ferns. Rapp do-nated a few to the Florida Experiment Station along with his mosses and lichens. I prepared a list of 63 species found in Alachua Co., which I distributed with my check list of mosses. Professor Kurz, at Tallahassee, has done some work on the group locally and helped to publish a neat pamphlet on the subject. James B. McFarlin published a state list in Proc. Fla. Acad. Sci. Aug. 1941.

#### ALGAE

The algae, or seaweeds, are not a homogeneous group but exhibit wide and fundamental variations. In many species the chlorophyll is obscured by other colors, thus we have the blue-green, green, brown and red subgroups. The number of species is immense. Some are used for food, others furnish agar-agar and the ashes of most of them supply iodin. Few have been preserved in fossil form except those that secrete lime or silica. Many species have been used in physiological studies because of their simple structure and the ease with which they can be controlled and observed. It is now generally believed that the fungi have been derived from the algae by the gradual adoption of a parasitic or saprophytic mode of life. A few of the students of American algae are given below. The marine species of Florida are pretty well known but those growing in fresh water need a great deal of study. The field is large and very inviting.

Francis Wolle, botanist, teacher and inventor, was born in Pa. in 1817. After he quit teaching he lived quietly at Bethlehem and worked on the algae. The "Desmids of the United States" appeared in 1884 and "Fresh Water Algae," 2 vols.,

in 1887. I frequently consulted these books while at Cornell, along with Farlow's "Marine Algae of New England," published in 1881.

Frank Shipley Collins was born in Boston, Mass., in 1848. He specialized on North American marine algae. His collection of 41,300 specimens was acquired by the New York Botanical Garden in 1922. His two most importnat works are "The Green Algae of North America" and, with Dr. A. B. Hervey, "The Algae of Bermuda." In association with Setchell and Holden, he also issued the "Phycotheca Boreali-Americana," a collection of dried specimens of the algae of North America which reached a total of 2,400 numbers.

William Albert Setchell was born in Norwich, Conn., in 1864, received the Ph.D. degree at Harvard in 1890 and became Professor of Botany at the University of

California in 1895. He specialized on marine algae.

Josephine E. Tilden was born at Davenport, Ia., received the M.S. degree at Minnesota in 1897, Ph.D. at Michigan in 1904 and became Professor of Botany at Minnesota in 1910. Her specialty was the Pacific algae. She distributed six centuries of American algae. Her "Minnesota Algae," published in 1910, bears a misleading title since only the blue-greens are treated and all known North American species are included.

bia in 1900 and began teaching there in 1902. He specialized on the morphology and phylogeny of the algae, while G. T. Moore and others worked on their physiology.

William Dana Hoyt was born at Rome, Ga., in 1880, received the Ph.D. degree at Hopkins in 1909 and taught botany at Washington and Lee. He studied the

marine algae of the southern United States.

Lewis Hanford Tiffany was born in Ill. in 1894, received the Ph.D. degree at Ohio State in 1923 and has taught botany there since, specializing in the physiology and taxonomy of the fresh-water algae. He contributed the Oedogoniales to "North American Flora."

William Randolph Taylor was born in Philadelphia, Pa., in 1895, received the Ph.D. degree at Pennsylvania in 1920 and taught botany there until 1930, when he went to Michigan. He worked on the marine algae of Florida and tropical America

and the fresh-water algae of Canada.

Marshall Avery Howe was born in 1867 at Newfane, Vt., graduated at the University of Vermont in 1890 and shortly afterwards was appointed an instructor in the University of California, where he became interested in seaweeds and also studied the liverworts. After taking the Ph.D. degree at Columbia in 1898 he remained two years at the university and then joined the Staff of the New York Botanical Garden as curator of the algae and liverworts. By exploration, purchase, gift and exchange these collections were greatly increased during the thirty-five years of his curatorship and he also published many important articles on the two groups. Many of the specimens were collected by him in Florida and her coastal waters in 1902 and 1904. As Dr. Howe grew older he took more interest in growing fine varieties of cultivated flowers, like dahlias and roses. He died at his home in Pleasantville, N. Y., in 1936, admired by all who knew him as a trustworthy scientist and a true gentleman.

Among the private collections of algae deposited at the New York Botanical Garden and curated by Dr. Howe was one of 4,000 sheets of Characeae brought together by Dr. Timothy Field Allen, an expert in this group. Other collections of importance acquired by the Garden were those of Rev. George W. Perry, Horace Averill, Col. Nicolas Pike and Dr. C. L. Anderson. Dr. Howe alone collected in

Florida and tropical America over 35,000 specimens.

Diatoms are especially attractive algae and they have been studied by many persons who are fond of using the compound microscope. There are about 150 genera and 5,000 known species in the family, dating back to the Cretaceous period and living in both salt and fresh water. Diatomaceous earth has long been known and used for various purposes; but as the basic link in the food chain these tiny brown

algae with their siliceous shells are of far greater importance.

Mr. Robert Hagelstein, born in N. Y. City in 1870, was for some time curator of the large collection of diatoms at the New York Botanical Garden. He made many of the collection records listed in Boyer's "Synopsis of North American Diatoma-He also acquired the famous collection of David B. Ward, of Poughkeepsie. Herman Gunter and Dr. G. D. Hanna presented a complete series of the samples used by Dr. Hanna in his study of the Florida peat diatoms.

#### CHAPTER VI

#### **FUNGI**

The larger fungi, with their peculiar forms and brilliant colors, must have attracted attention from time immemorial. They could also be studied without a microscope. Hence we find as early as the eighteenth century many volumes of good descriptions and figures of the more conspicuous European species. Schaeffer's "Bavarian Fungi" was one of the first of these. There are four volumes, with 330 plates, published in 1762–74. Scopoli's "Flora Carniolica," with 65 plates, appeared in 1772. The first name for our destructive Clitocybe root-rot dates back to this publication. Batarra's work, with 40 plates, was published in 1775 but is not binomial. Works by Jacquin, Batsch and Bulliard next appeared. In his "Herbier de la France," published in 1780–93, Bulliard had 600 plates; in "Histoire des

Champignons de la France," which appeared in 1791-1812, there are 700 plates. The text of Paulet's "Traité des Champignons" appeared in 1793, while the 217 plates were issued in fascicles from 1812 to 1935. Bolton's work on the fungi of Halifax appeared in 1788-91, with 182 plates, and his "Geschichte der Pilze, also with 182 plates, in 1795-1820. Sowerby's "English Fungi" was published in 1795-1815, with 440 colored plates. This work greatly stimulated the study of the larger fungi in England, as did that of Schaeffer in Bayaria and of Bulliard in France.

In the first half of the nineteenth century work on the larger fungi was continued in Europe and begun in America. A set of exsiccati also appeared. On the continent several illustrated works were published, such as those of Sturm, Rostkovius and Krombholz in Germany; Westendorp in Belgium; and Vittadini in Italy. on edible fungi. French fungi were treated by de Candolle in his "Flore Française, while Desmazières distributed 2200 specimens of French cryptogams, many of which were fungi. Persoon's work was prominent in this period, beginning with several short papers just before the close of the eighteenth century. His "Synopsis Fungorum," of 706 pages, appeared in 1801 and his "Mycologia Europaea," in three illustrated volumes, in 1822-28. Meanwhile, Fries, the famous Swedish mycologist, had begun to publish. His "Observations" appeared in 1815–18; the "Systema," in three volumes, in 1821–32; the "Epicris," with 610 pages, in 1838; "Hymenomycetes Europaei," with 755 pages, in 1874; and his "Icones," with 200 large colored plates, in 1867-84. This last work was more or less supplementary to those previously mentioned.

Christian Hendrick Persoon was born in 1755 in the Cape of Good Hope, his father a Dutch planter and his mother a Hottentot. In 1767 he came to Holland and studied medicine at Leiden. Having inherited a small income he studied plants, especially the fungi, as a hobby and began to publish while at Göttingen. In 1800 he moved to Paris but his ugly features and repulsive habits prevented him from making friends; his income vanished and he was reduced to poverty. In 1825 he presented his herbarium to the University at Leiden and was pensioned for a time by the Dutch Government but died in Paris in 1837, poor and friendless. It is unfortunate that he lacked means for publishing more, because his botanical knowledge was thorough and original. His herbarium was put in shape for study at my request under the direction of Dr. Lotsy.

In England S. F. Gray published his natural arrangement of British plants, including the fungi, in 1821. This was in two large volumes with 21 plates. Badham's Treatise on edible fungi, with 20 plates, appeared in 1847, and Mrs. Hussey's splendid work, with over a hundred colored plates, in 1847-55. Meanwhile, American fungi were beginning to receive attention. A few had already been sent to Linnaeus but near the close of the eighteenth century Olof Swartz began to publish his illustrated flora of the West Indies, in which several fungi were described. important work of over 2,000 pages and 29 plates appeared in 1797-1806. In 1811 Louis Bosc published an illustrated paper on some fungi found in the southeastern United States. In it there is a description of our common large field puffball. Schweinitz published his fungi of North Carolina in 1822 and his synopsis of North American fungi in 1832. Léveillé and Montagne, in France, now began to publish extensively on exotic fungi, many of which came from America. Montagne's large work on Cuban plants, with 549 pages and 20 plates, appeared in 1842. It contains good descriptions and figures of some of the larger fungi.

The mycological work of the second half of the nineteenth century was partly like that which preceded it and partly modern, dealing with parasitic and microscopic forms. DeBary, sometimes called the founder of modern mycology, studied the morphology of parasitic fungi, and men like Berkeley, Klebahn, Rostrup, Eriksson, Cavara and Brefeld followed his lead. In 1885 a section of mycology was established in the U. S. Department of Agriculture. This was the beginning of a great expansion in mycology as well as plant pathology, not only in Washington but in the various states. Before an investigator could effectively deal with a plant disease he had to know the causative agent. Galloway, Smith, Waite, Ellis, Tracy, Earle, Underwood and many others became active in this newly developed field, while teachers like Farlow, Bessey, Atkinson and Jones trained students for the

many new positions awaiting them.

Following the older lines of research in the taxonomy of the fungi there were many workers, both in Europe and America, who published voluminously and others who distributed sets of named specimens. England was represented by Berkeley and Cooke; Finland by Karsten; Sweden by Eriksson; Hungary by Kalchbrenner;

Austria by de Thuemen and Bresadola; France by Quélet, Richon & Roze, Lucand, Gillet, Boyer and Roumeguère; Italy by Barla, Cavara, Lanzi and Saccardo; and Germany by Rabenhorst, the Sydows, Krieger, Schroeter, Allescher & Schnabl and Engler & Prantl. A few of these should receive more than passing mention.

Rev. Miles Joseph Berkeley was born in England in 1803 of a famous family, educated at Cambridge and performed the arduous duties of a clergyman until his death in 1889. His leisure time was devoted to the fungi and his publications on this group were many and important. Early American mycology was largely based upon his work. Curtis and Ravenel both sent him their specimens to name and all of Wright's new finds in Cuba were described by him.

Bresadola was a careful worker and knew his species both in the field and in the herbarium. He had the confidence of herbarium curators and could borrow anything he wished for study. I spent several months with him. When it came to American material he made some mistakes, which was natural. Saccardo I did not like so well but his great work on all described species of fungi is invaluable. The same may be said of Engler & Prantl's "Natural Plant Families." The fifteen

mycological parts of this work appeared from 1889 to 1907.

Some American mycologists of this period were Curtis, Ravenel, Ellis, Peck, Frost, Morgan, Cragin, Farlow, Gibson, Tracy, Earle, and Underwood. Moses Ashley Curtis was born in Stockbridge, Mass., in 1808, graduated at Williams College in 1827 and became tutor three years later in the family of Governor Dudley at Wilmington, N. C. In 1834 he published a list of the plants growing wild in the vicinity of Wilmington, which was followed by other botanical articles. In 1838 he returned to Massachusetts, prepared for the ministry and taught six years in an Episcopal school. In 1856 he settled at Hillsborough, N. C., and devoted himself to botanical studies until his death in 1872. In collaboration with M. J. Berkeley, of England, he made valuable contributions to the early literature of American fungi.

Benjamin Matlock Everhart was born near Westchester, Pa., in 1818 and after some years spent in business devoted his time to botany. He specialized in mosses, lichens and liverworts but helped Ellis with the fungi. The two men founded the

"Journal of Mycology."

Henry William Ravenel was born in Berkeley, S. C., in 1814, graduated at South Carolina College in 1832 and lived on his plantation until 1853, when he settled in Aiken until his death in 1887. A year before he died the University of North Carolina conferred upon him the degree of LL.D. Deafness prevented him from teaching, but he was botanist for the State Department of Agriculture. While managing his farm he made a large botanical collection. The flowering plants went to Converse College, S. C.; the lichens, mosses and algae to the London Museum. Over fifty species were named for him. In 1852-60 he issued five centuries of "Fungi caroliniani exsiccati," and in 1878-82 eight hundred specimens of "Fungi americani exsiccati." Moses A. Curtis, of North Carolina, was a good friend of his. These two men were the leading American mycologists of their time and, indeed, about the only persons in America who knew much about the fungi. Thus it came about that many species occurring in Florida were studied and described some years before species found in the northern states.

George Martin was born in Pa. in 1826, received the M.D. degree at Pennsylvania in 1847 and after the war settled in Westchester, Pa., where he died in 1886. He collected a number of fungi in Florida and contributed articles to the "Journal

of Mycology."

Job Bicknell Ellis was born at Potsdam, N. Y., in 1829, received the degree of A.B. at Union College in 1851 and taught at various places. His great contribution to science, however, was the collection and description of fungi, especially the inconspicuous ones on leaves and dead branches. His collection of 80,000 specimens, so full of types, is at the New York Botanical Garden. I went with Dr. Underwood to see Mr. Ellis shortly before his death in 1905, when the details of transfer were arranged. In this collection are numerous specimens from Florida collected by Calkins and others. B. M. Everhart was co-author of many of his published species.

Charles Horton Peck was born at Sand Lake, N. Y., in 1833, received the A.M. degree at Union College in 1862 and became Botanist of the New York State Museum, at Albany, in 1867. During the long years that followed he described hundreds of new species of fungi from New York and other states. These descriptions are clear and concise, and most of the types are still to be seen at Albany. Charles C. Frost, a Vermont shoemaker, sent specimens to Peck and also published in 1874 a catalog of the boletes of New England with descriptions of new species.

Andrew Price Morgan published on the mycologic flora of the Miami Valley, Ohio, from 1883 to 1885 and later undertook to monograph the North American species of Marasmius. Peck named the large green-spored *Lepiota* for him. I collected it in Brazil under an older name. It is one of the most prominent fungi along our Florida highways during the summer rainy season, and is poisonous. Francis W. Cragin, in 1884, published a list of the larger fungi known to occur in Kansas. In 1895 William Hamilton Gibson got out a handsome book on edible and poisonous mushrooms with 337 pages and 38 plates. This is a classic.

Since 1900 mycology has developed mainly along lines already laid down. There has been, however, more splitting of genera, more detailed descriptions of species and wider recognition of the value of types. The American code of nomenclature has come and gone, supplanted by a revised international code, which may itself pass away in time. Knowing a plant by several names has become a custom,

sometimes quite confusing if not positively annoying.

Among those in Europe working with the larger fungi since 1900 were Bresadola, Romell, Boudier, Hennings, Patouillard, Ricken and Massee. In America, Atkinson, Kauffman, Seaver, Lloyd, Burt, Overholts, Burlingham, and many others. Mushroom books were prepared by Atkinson, Marshall, Hard and McIlvaine. Sets of American fungi were issued by Griffiths, Kellerman, Bartholomew, etc. The first chairs of Phytopathology in America were established early in the present century. A list of recent mycologists who have studied the smaller fungi, parasitic and otherwise, in Europe and America would be far too long to find place in this brief sketch.

I shall therefore omit most of them from the present discussion.

Bresadola has already been mentioned as one of the most reliable mycologists in Europe. In the same class I would place Romell, of Sweden, and Patouillard, of France. I knew them both very well. Romell was a lawyer and a disciple of Fries who studied the fungi as a hobby. He bought Bresadola's herbarium. I secured many of Bresadola's best specimens for the New York Botanical Garden but felt that his main collection should remain in Europe. Patouillard was a druggist in Paris who worked at mycology while not filling prescriptions. He had his own collection and library but often examined the larger collection in the Jardin des Plantes. He published on the fungi of Guadeloupe and other parts of America. Boudier

lived near him in a splendid mansion.

Hennings was an excitable, unreliable sort of person who perspired over dusty bundles of fungi sent in from the uttermost parts of the earth to the Berlin Botanic Garden when Engler was director. He inspired my distrust when he claimed to remember the spore measurements of scores of species. Maybe he did. I liked Magnus, the rust specialist, much better. He was a big jovial bachelor who could laugh loudly over a small joke and go to the Zoo with me with a clear conscience. He was not so different from our Underwood. Massee, who followed Berkeley and Cooke at Kew, was exceedingly kind. He remarked to me one day, when I was examining some Berkeley & Curtis types, that he wished they were all in America where they belonged. I agreed with him. What a boon it would be to Florida botanists if they could get back all the plants taken from the state, correctly named!

Turning now to some American mycologists of this period, Carlo Luigi Spegazzini, 1858–1926, was the most prominent botanist actually residing in South America in his day. He was born in Italy and came to Argentina about 1882, where he devoted most of his time to a study of its vegetation, publishing over a hundred articles on grasses, cacti, fungi, etc. I visited him at his comfortable home in La Plata to examine his fungous collection. He was extremely cordial and gave me

hundreds of valuable specimens to take back to New York.

William Gilson Farlow was born in Boston in 1844, received the M.D. degree at Harvard in 1870 and studied a year in Germany. His honorary degree of LL.D. was bestowed by Harvard in 1896. In 1874 he began his long career of teaching at Harvard in the field of cryptogamic botany, sending out many fine teachers and investigators. He also built up a large library and collection of fungi and algae. With the assistance of A. B. Seymour he published a host index of parasitic fungi, and he and Krieger prepared a fine illustrated work on some of the fleshy fungi. Dr. Farlow was very conservative and careful. Sometimes he would return from the woods with but a single specimen, but it would be studied in minute detail. On a visit to my fungous herbarium at the New York Botanical Garden he remarked upon the ample space, saying that where I had one specimen he could store a hundred. In his day specimens were carved into small bits, to go into envelopes, while I used boxes so as to keep the specimens entire. Where space is limited a few samples of

large fungi may be kept in boxes and the rest, for distribution records, sliced and

mounted in envelopes.

Joseph Charles Arthur was born at Lowville, N. Y., in 1850, studied at a number of universities, taught botany at Minnesota, Wisconsin and Purdue and was botanist at the Agricultural Experiment Station in Lafayette, Ind., from 1888 to 1915, when he became an emeritus. His specialty was the plant rusts, in which field he was dominant. He had a number of assistants at various times. One of these was Frank Dunn Kern, born at Reinbeck, Ia., in 1883. He received the M.S. degree at Purdue in 1907, Ph.D. at Columbia in 1911 and finally settled down as Professor of Botany in Pennsylvania State College in 1913. Both Arthur and Kern, as well as Hedgcock and other students of rusts, have been to Florida and Mr. Erdman West has sent them considerable material from the state.

Elam Bartholomew was born in Strasburg, Pa., in 1852 and received the M.S. degree at Kansas College in 1898. Since 1901 he has distributed "Fungi Columbiani" and "N. Am. Uredinales."

John Jefferson Davis was born at Davis, Ill., in 1852, received the B.S. degree at Illinois in 1872 and practised medicine from 1875 to 1911, when he became Curator of the Herbarium at Wisconsin University. For many years he was an expert on parasitic fungi, especially those of Wisconsin. He died in 1937.

John Dearness was born in Hamilton, Ont., in 1852 and taught biology in London, Can., for many years while specializing on certain groups of fungi. He was

given an honorary LL.D. degree in 1926.

William Ashbrook Kellerman was born at Ashville, O., in 1850 and received the Ph.D. degree at Zürich in 1881. From 1883 to 1891 he was Professor of Botany at the Kansas State Agricultural College, where he specialized on smuts and rusts.

His son Karl became a plant physiologist.

George Francis Atkinson was born in Monroe, Mich., in 1854, received the Ph.B. degree at Cornell in 1885 and held positions in North Carolina, South Carolina and Alabama. He was head of the botanical department at Cornell from 1896 until near his death in 1918. Although jealous and disagreeable in disposition he was well-nigh perfect in directing investigation, possessing great energy and enthusiasm both for his own work and for that of his students. I collected scores of mushrooms which he photographed for his mushroom book, and was amazed at the untiring

patience he always exhibited.

Franklin Sumner Earle was born in Dwight, Ill., in 1856 and entered the University of Illinois in 1872, where he came under the influence of Dr. Burrill. The two published an account of the powdery mildews of the state. In 1892-5 he was at the Mississippi Agricultural Experiment Station, then after a year in Washington became Professor of Biology at the Alabama Polytechnic Institute for five years. In 1897 he and Underwood published a list of Alabama fungi. From 1901 to 1904 he was mycologist at the New York Botanical Garden, then for two years Director of the Cuban Agricultural Experiment Station. While there I joined him for a collecting trip over most of the island. He had a little home at Herradura. In 1918 his house was burned and all his collections destroyed. Professor Earle was very facile with his pen. His book on the culture of sugar-cane was written on my front porch without a reference book or a note of any kind. He died at Herradura in 1929.

Roland Thaxter was born at Newton, Mass., in 1858, received the Ph.D. degree at Harvard in 1888 and was Mycologist at the Connecticut Agricultural Experiment Station from 1888 to 1891, when he accepted the chair of cryptogamic botany at Harvard. His work on the Laboulbeniaceae is outstanding. He died in 1932.

Arthur Bliss Seymour was born at Moline, Ill., in 1859, received the M.S. degree from Illinois University in 1886 and became an assistant in the Cryptogamic Herbarium at Harvard the same year. He spent much time on the bibliography of North American fungi and published with Dr. Farlow a host index of parasitic fungi

which has been extremely serviceable.

Edward Angus Burt was born at Athens, Pa., in 1859, received the Ph.D. degree at Harvard in 1895 and was appointed Professor of Natural History at Middlebury College, in Vermont, the same year. Later, while mycologist at the Missouri Botanical Garden, he published several important papers on the Thelephoraceae of North America, this group being his specialty. Dr. Burt was a thorough student and one of our best mycologists. I shall always be indebted to him for working so patiently on the thelephores I collected in tropical America and elsewhere. He retired in 1925, after twelve years work in St. Louis. Curtis Gates Lloyd, born at Florence, Ky., in 1859, built up in Cincinnati a good

library and a collection of the larger fungi, many of which came from Florida. His best work was done on the puffballs. Having plenty of money and leisure, he spent much time abroad buying books and photographing specimens in various herbaria. Unfortunately, he suffered from an inferiority complex due to his lack of college training and fondly hoped that by attempting to pull others down he might elevate himself. Most of his photographic work is excellent and probably reliable but one cannot be sure of his personal observations, comments or descriptions. If he had received the proper training early in life, there is no telling what he might have accomplished, for he ardently desired to be considered a great mycologist.

Cornelius Lott Shear was born at Coeymans Hollow, N. Y., in 1865, received the A.M. degree at the University of Nebraska in 1901 and was Plant Pathologist in the U. S. Department of Agriculture from 1902. He spent some time in Florida

collecting fungi, his special group being the pyrenomycetes.

George Perkins Clinton was born at Polo, Ill., in 1867, received the Sc.D. degree at Harvard in 1902 and the same year became Botanist at the Connecticut Agricultural Experiment Station. He was an expert on plant smuts. His death occurred in 1937. Clinton was one of the few men who early became acquainted with the virulent nature of the chestnut canker from actual observation. He supported me ably in my battle at the Harrisburg Convention against great odds.

Miss Gertrude Simmons Burlingham, born in Mexico, N. Y., received the Ph.D.

degree at Columbia in 1908 and did excellent taxonomic work on Lactaria and Russula. She has been spending her winters in Florida for some years collecting

and studying certain groups of gill-fungi.

Howard J. Banker was born in Schaghticoke, N. Y., and died in 1940 at the age of seventy-four. In 1901 he received the M.A. degree from Columbia, and Ph.D. in 1906. From 1904 to 1914 he was Professor of Biology at DePauw University, then worked for the Carnegie Institution on human heredity. His herbarium of nearly 5,000 specimens was donated to the New York Botanical Garden. He specialized on the Hydnaceae.

Henry Curtis Beardslee was born in Painesville, O., in 1865, graduated at Western Reserve in 1889 and taught science in the University at Cleveland for ten years. He was senior master of the Asheville School in North Carolina for twenty years, then retired to spend his summers in Ohio and his winters in Florida. For a large part of his life his chief interest was centered in the collection and study of the fleshy fungi. He was a careful worker and his publications are valuable.

Calvin Henry Kauffman was born at Lebanon, Pa., in 1869 and studied at Harvard, Wisconsin and Cornell. In 1904 he became Instructor in Botany at the University of Michigan, where he studied the gill-fungi of the state for many years and wrote an excellent account of them. He was the only American acquainted with

the difficult genera Cortinarius and Inocybe. He died in 1931.

Albert Osbun Garrett was born in Lawrence, Kan., in 1870, received the A.B. degree at Kansas in 1894 and while teaching at Salt Lake City specialized on the rusts and smuts of Utah.

John William Hotson was born in Ontario in 1870, received the Ph.D. degree at Harvard in 1913 and taught mycology at Seattle, specializing on rusts and gill-fungi.

David Ross Sumstine was born at Somerset, Pa., in 1870, received the Sc.D degree at Gettysburg in 1910 and taught in Pittsburgh while studing the mucoraceae

and hyphomycetes. He has collected many fungi in Florida.

Dr. William Sturgis Thomas, 1871-1941, was a specialist in allergy in New York City. He became interested in mushrooms and published a book on them in 1928, with an enlarged edition in 1936. He helped found the N. Y. Mycological

Society and for several years served as its president.

William Chambers Coker was born at Hartsville, S. C., in 1872, received the B.S. degree at the University of North Carolina in 1894 and Ph.D. at the Hopkins in 1901. In 1902 he joined the Staff of the University of North Carolina as Associate Professor of Botany, becoming a full professor in 1908. His publications on fungi are important and finely illustrated. They contain many species found in Florida. His illustrated work on trees is also much used in the state.

Edward Monroe Freeman was born in St. Paul, Minn., in 1875 and taught at Minnesota from 1907 to date. Although a mycologist he published a good account

of Minnesota plant diseases.

Edward Martinius Gilbert was born at Blair, Wisc., in 1875, received the Ph.D. degree at Wisconsin in 1914 and taught botany there to date. He specialized on certain groups of the basidiomycetes.

Fred Jay Seaver was born in Iowa in 1877 and received the Ph.D. degree at Iowa University in 1912. After considerable teaching experience he joined the Staff of the New York Botanical Garden in 1908 and took charge of the fungi below and including the rusts while I curated the groups above them. His specialty was the discomycetes, and when I retired he handled "Mycologia" with great success.

Herbert Spencer Jackson was born in Augusta, N. Y., in 1883, studied at Cornell, Harvard and Wisconsin and became Chief Botanist at Purdue Experiment

Station in 1915, specializing on rusts and smuts. In 1929 he became Professor of

Mycology at Toronto, where he specialized on the Thelephoraceae.

Walter Byron McDougall was born in Mich. in 1883, received the Ph.D. degree at Michigan in 1913, taught botany at Illinois until 1929 and entered the National Park Service in 1935. He specialized on mycorrhizas, mushrooms and ecology. Sanford Myron Zeller was born in Mich. in 1885, received the Ph.D. degree at

Washington (St. Louis) in 1917 and became plant pathologist at Oregon State in 1919, where he worked in forest pathology and specialized on the taxonomy of certain groups of fungi.

Harry Morton Fitzpatrick was born in Greenwood, Ind., in 1886, received the Ph.D. degree at Cornell in 1913 and has taught mycology at Cornell ever since. His publications cover several difficult groups of fungi and he has done considerable

editorial work.

Lee Oras Overholts was born in Camden, O., in 1890, received the Ph.D. degree at Washington (St. Louis) in 1915 and has since taught in Pennsylvania State College. His specialties have been the taxonomy of the fungi and forest pathology, with emphasis on the polypores. When he began on this group in Ohio he sent his collections to me for determination and accepted my classification with enthusiasm. When he took work under Burt for his doctorate he was much disturbed by his new teacher's conservative attitude; so he wrote to me for advice and I of course replied, "When in Rome do as the Romans do." From that day to this he has been a reactionist. In spite of ill health he has dome much careful and valuable work.

William Webster Diehl was born in Logansport, Ind., in 1891 and received the M.S degree at Iowa College in 1915. He began mycological work with the U.S.D.A.

in 1917, specializing on the ascomycetes.

John Nathaniel Couch was born in Va. in 1896, received the Ph.D. degree at North Carolina in 1924 and has taught botany there since. He specialized in the taxonomy of the basidiomycetes.

Lichens were once considered a group by themselves; then an association of algae and fungi in symbiotic relation; and finally fungi parasitic on algae. A lichenist of the old school was Edward Tuckerman, who was born in Boston in 1817, graduated at Union College in 1837, and after a year in Europe received the A.B. degree at Harvard in 1847. In 1858 he became Professor of Botany at Amherst and devoted his spare time to the lichens. His work on the genera appeared in 1872 and the first part of his "Synopsis of North American Lichens" in 1882.

Bruce Fink was born at Blackberry, Ill., in 1861, received the A.M. degree at Harvard in 1896 and Ph.D. at Minnesota in 1899. After teaching at two other places he joined the faculty of the University of Miami (Ohio) in 1906 and remained there many years. His special subject was the lichens of the United States, which he treated as parasitic fungi in accordance with modern ideas of classification.

Severin Rapp was born in Germany in 1853, came to America in 1883, and settled the following year in Sanford, Fla., where he worked as a shoemaker until 1911. then devoted all his time to collecting plants, especially mosses and lichens. After his death in 1941 his collection came to the Florida Agricultural Experiment Station. There is still much work to be done on the lichens of the state.

Attention was directed to bacteria as causative agents in plant diseases by Thomas Jonathan Burrill, born at Pittsfield, Mass., in 1839, and Professor of Botany and Horticulture at the University of Illinois from 1868 to 1902. Working on the diseases of plants caused by parasitic fungi, he discovered that bacteria also could cause disease in plants as well as in animals. This important discovery opened up a new field of research. Burrill's work on fire blight was continued by J. C. Arthur and M. B. Waite.

Erwin Frink Smith was born at Gilbert's Mills, N. Y., in 1854, received the Sc.D. degree at the University of Michigan in 1889 and became Plant Pathologist in

the U.S. Department of Agriculture in 1886. In 1893 he entered the field of bacterial diseases of plants opened up by Burrill's work on fire blight. He told me once that he wasted ten of the best years of his life on peach yellows, but I think he accomplished quite a bit with what he had left.

Many other men have investigated bacterial diseases of plants since the time of Burrill and Smith but they have usually worked on parasitic fungi also and are to be classed with plant pathologists. Recently much attention has been given to soil

bacteria and the general field of microbiology.

Jacob Goodale Lipman was born in Russia in 1874, received the Ph.D. degree at Cornell in 1903 and devoted many years to the study of soil bacteria at Rutgers University, in New Jersey.

Harold Joel Conn was born in Middletown, Conn., in 1886, received the Ph.D. degree at Cornell in 1911 and worked on soil bacteria at the Geneva Experiment Station in N. Y. for many years.

The slime molds were classified as animals by deBary but their fruiting stages resemble those of the fungi. Some botanists even go so far as to place the fungi in a third kingdom parallel to animals and plants, but at present they must feel very lonely. Our American authority on the myxomycetes has been Thomas Huston Macbride, who was born at Rogersville, Tenn., in 1848 and was Professor of Botany in the University of Iowa from 1884 to 1914, when he became President. Since his death in 1934 Robert Hagelstein, now Honorary Curator of Myxomycetes at the New York Botanical Garden, has been very active in this field. He visited Florida recently and looked over the large array of species collected in the state by Mr. Erdman West, Mycologist of the Florida Agricultural Experiment Station.

### Edible and Poisonous Fungi

Very little has been done in America to promote the use of wild mushrooms for My booklet and large colored mushroom chart were only a start in this direction. Peck ate a good many fleshy fungi and his list of edible species is given in my booklet. In my long series of colored figures of fungi published with descriptions in "Mycologia" I often refer to the work of W. W. Ford, who tested a number

of poisonous species, both chemically and physiologically.

One of the first things I did on coming to Florida was to cook and eat six large caps of the green-spored *Lepiota*. I spent twelve miserable hours but was able to keep my records straight. Tons of excellent mushrooms go to waste in Florida after every rainy spell. I described 600 new species but could test very few of them. The time will come, however, when every market will have a special place for mushrooms with an expert in charge to see that no mistakes are made. The climate does not favor the cultivation of mushrooms but there is no scarcity of wild ones.

# CHAPTER VII

## PLANT PATHOLOGY

Although this subject is classed as applied mycology, so many of the men engaged in it have added materially to our mycological knowledge that a brief sketch of its history is entirely in order here. To treat the subject fairly, even for the past century, would require many volumes. The public is always more ready to provide funds for what appears practical than for research in pure science, little realizing that

the two are inextricably interwoven.

At the beginning of the nineteenth century parasitic fungi were considered the cause of most plant diseases. Such outstanding mycologists as Bulliard, Link and Tulasne thoroughly believed this but did little to prove it. Then Louis Pasteur overthrew the theory of spontaneous generation; Anton de Bary carefully worked out the morphology and life history of many parasitic fungi; and the potato blight, cereal rusts and smuts, and other diseases of great economic importance impressed upon the general public the value of research in this field.

The founder of modern plant pathology was Julius G. Kühn, born in 1825, who published a book on the diseases of cultivated plants in 1858. Other phytopathologists of the period were M. J. Berkeley, A. S. Oersted, Ernst Hallier, Robert Hartig,

A. B. Frank and Paul Sorauer.

When Millardet accidentally discovered Bordeaux Mixture and saved the great wine industry of France a new era in plant pathology began. About the same time, in 1885, a section of Mycology was established in the U.S. Department (Bureau) of Agriculture with F. Lamson-Scribner at its head, and two years later the name was changed to Vegetable Pathology. In 1889 B. T. Galloway became head of the new section and selected for his Staff such men as E. F. Smith, M. B. Waite, David Fairchild, W. T. Swingle, H. J. Webber and A. F. Woods. Burrill, working on fire blight in Illinois from 1874 to 1884, had discovered that bacteria could cause disease in plants. E. F. Smith was transferred to this interesting field in 1893. Meanwhile, college professors like Bessey, Farlow and Tracy were working overtime getting young men ready for scores of new positions opening up rapidly.

In Europe Hartig founded forest pathology, Frank worked on sugarbeet diseases, Brefeld on smuts and Klebahn and Eriksson on rusts. Rostrup was also active in Denmark and Woronin in Russia. The greatest English phytopathologist of the period was H. Marshall Ward; while in Australia there was Daniel McAlpine; in

France, Prillieux and Delacroix; and in Italy, F. Cavara and others.

In America numbers of new workers joined the ranks of those studying and fighting plant diseases. Not only in Washington but also in most of the states groups of trained men were brought together for this purpose. In 1906 the first chairs of Plant Pathology were established in American universities. The founding of the American Phytopathological Society in 1909 and the inauguration of its valuable journal "Phytopathology" in 1911 gave great stimulus to the whole movement. Then came the Quarantine Act of 1912 (fully a century late), the substitution of sulfur for copper in fungicides, and the breeding by W. A. Orton and many others

of resistant strains in crop plants.

There is no doubt that the chestnut canker had a profound effect upon all classes of people in the regions where the tree flourished. Before its devastating inroads upon our valuable chestnut forests few believed that such a thing could happen. The public was alarmed and scientists aroused to greater exertions. The politicians, too, saw a chance to fill their pork barrels. In Pennsylvania a plan was formulated to spend many thousands of dollars to fight the fungus, which I had already shown by experiments to be a hopeless undertaking. The Washington pathologists were wholeheartedly for it because they were ignorant and furiously jealous. Only Clinton and Stewart stood by me at the Harrisburg Convention, and we three were ridiculed beyond measure. However, A. F. Woods was in the chair and he invited me to make an address after the committee had submitted an unanimous vote of approval to the plan.

This address was listened to with great interest by delegates from other states where appropriations were contemplated. My knowledge of the disease appeared to them so complete and my manner so earnest that not a single other state joined Pennsylvania in its useless and wasteful scheme. Had the disease been recognized and wiped out in Long Island when it was first introduced that would have been a different matter but before I became mycologist at the New York Botanical Garden it had already spread over such a wide area that nothing could then be done to stop it. The severity of this disease, introduced from the Orient, hastened the passage of the

Quarantine Act.

I should like to mention here some of the prominent names associated with plant pathology in America in the present century but it is hard to decide where to begin and when to stop. Perhaps a brief alphabetical list will be helpful without exceeding space limitations.

exceeding space limitations.

Dow Vawter Baxter was born in Hillsboro, Ill., in 1898, received the Ph.D. degree at Michigan in 1924 and has taught there since, with forest pathology as his specialty. His study of resupinate species of polypores and their effect on trees and

timber has been outstanding.

Ernst Athearn Bessey was born at Ames, Ia., in 1877, received the A.M. degree at Nebraska in 1898 and Ph.D. at Halle in 1904. From 1906 to 1908 he was Plant Pathologist in charge of the Subtropical Laboratory at Miami, then in Louisiana for two years and in 1910 became Professor of Botany at Michigan State, where he is still active. His specialties are phytopathology, mycology and the phylogeny of the fungi.

Henry L. Bolley, born at Holman, Ind., in 1865, received the M.S. degree at Purdue in 1889 and became Professor of Botany at North Dakota College in 1890. He worked on cereal smuts and rusts and breeding for disease resistance.

John Shaw Boyce was born in Ireland in 1889, received the Ph.D. degree at Stanford in 1917 and was employed by the U. S. Department of Agriculture as forest pathologist until 1929, when he became Professor of Forest Pathology at Yale.

Owen Francis Burger was born at Freeland, Pa., in 1885, received the M.S. degree at Florida in 1911, Sc.D. at Harvard in 1916 and worked in plant pathology at the Florida Experiment Station four years, taught at California two years and became pathologist in the U. S. Department of Agriculture in 1918, specializing on fruit diseases. For several years, until his tragic death in 1928, he was Plant Pathologist at the Florida Experiment Station.

Melville Thurston Cook was born at Coffeen, Ill., in 1869, received the A.M. degree at DePauw in 1901 and Ph.D at Ohio State in 1904. He taught at DePauw from 1895 to 1904, spent three years in Cuba and four in Delaware, and was Plant Pathologist at the New Jersey Experiment Station from 1911 to 1923, when he went

to Porto Rico. His specialties were plant pathology and vegetable galls.

Bernard Ogilvie Dodge was born at Mauston, Wisc., in 1872, received the Ph.D. degree at Columbia in 1912, taught at Columbia from 1909 to 1920, and then entered the U. S. Department of Agriculture as pathologist of fruit diseases. Since 1928 he has been Plant Pathologist at the New York Botanical Garden, devoting his time chiefly to diseases of ornamentals.

Claude Wilbur Edgerton was born at Woodbine, Ia., in 1880, received the Ph.D. degree at Cornell in 1908 and was Plant Pathologist at the Louisiana Experiment Station from 1908 to 1924, when he became Professor of Botany and Plant Pathology

at Louisiana University.

David Grandison Fairchild was born in Michigan in 1869, received the B.S. degree at the Kansas State Agricultural College in 1888, studied in Europe and became a plant pathologist in the U.S. Department of Agriculture. In 1897 he was shifted to plant introduction and in 1898 appointed Agricultural Explorer, in which field he was eminently successful. He had a home at Coconut Grove, Fla., for many years and directed the plant introduction work at Chapman Field.

Howard Samuel Fawcett was born at Salem, O., in 1877, received the M.S. degree at Florida in 1908, Ph.D. at Hopkins in 1918 and was Plant Pathologist at the Florida Experiment Station from 1906 to 1912, when he accepted a call to Cali-

fornia as an expert on citrus diseases.

Beverly Thomas Galloway was born at Millersburg, Mo., in 1863, received the B.S. degree at Missouri in 1884 and entered the U.S. Department of Agriculture in 1887. After long and distinguished service he died in 1938. His specialties were plant pathology and plant physiology. He was honored by Missouri with an LL.D. degree in 1902.

Levi Otto Gratz was born at Bluffton, O., in 1894, received the Ph.D. degree at Cornell in 1923 and was plant pathologist at the Florida Experiment Station from 1923 to 1942, when he was appointed director of research. He specialized on diseases

of Irish potatoes and tobacco.

Arthur Harmount Graves was born at New Haven, Conn., in 1879, received the Ph.D. degree at Yale in 1907 and taught there until 1914. For three years he was forest pathologist in the U.S. Department of Agriculture and in 1921 became Curator of Public Instruction at the Brooklyn Botanic Garden, where he has been trying to develop a strain of our native chestnut which is resistant to canker.

John Gasser Grossenbacher was born in Switzerland in 1875, received the A.B. degree at Missouri in 1906 and, after teaching a few years and doing research in plant pathology for eight years, became grove expert and manager of the Florida Insecti-

cide Co., with headquarters at Apopka.

Byron David Halsted was born at Venice, N. Y., in 1852, received the Sc.D. degree at Harvard in 1878, was Professor of Botany four years at Iowa State and came to Rutgers in 1889, where he worked on plant diseases and plant breeding. He died in 1018.

Carl Hartley was born in Lincoln, Nebr., in 1887, received the Ph.D. degree at California in 1920 and was pathologist in the U. S. Department of Agriculture almost

continuously from 1911 to date, working on diseases of forest trees.

Frederick DeForest Heald was born in Midland City, Mich., in 1872, received the B.S. degree at Wisconsin in 1894 and Ph.D. at Leipzig in 1897. He taught at Nebraska from 1903 to 1908, was Professor of Botany at Texas from 1908 to 1912, spent twelve years working on the chestnut canker and became Professor of Plant Pathology in Washington State in 1925. His "Manual of Plant Diseases" appeared

in 1926.

George Grant Hedgcock was born at Augusta, Ill., in 1868 and received the degree of A.M. at the University of Nebraska in 1901, In the following year he became Plant Pathologist in the U.S. Department of Agriculture until his retirement Among his specialties were diseases of forest trees, including rusts on in 1937. conifers. He spent much time in Florida.

Lexemuel Ray Hesler was born at Veedersburg, Ind., in 1888, received the Ph.D. degree at Cornell in 1914 and, after several years at Cornell, became Professor of

Botany at Tennessee in 1919, specializing on mycology and fruit diseases.

Bascombe Britt Higgins was born in N. C. in 1887, received the Ph.D. degree at Cornell in 1913 and then became Botanist of the Georgia Experiment Station. In addition to phytopathological work he has studied the morphology of certain ascomycetes.

Nathaniel Orson Howard was born at Providence, R. I., in 1880, received the Ph.D. degree at Brown in 1925 and was forest pathologist in the U. S. Department of Agriculture from 1918 to 1922, when he became an instructor in botany at Brown.

He worked with diseases of forest and ornamental trees.

Clarence John Humphrey was born in Cleveland, O., in 1882, received the Ph.D. degree at Wisconsin in 1920, was assistant in mycology at Cornell from 1907 to 1909 and became forest pathologist in the U. S. Department of Agriculture from 1910 to

1926, when he went to Manila.

Lewis Ralph Jones was born at Brandon, Wisc., in 1864 and received the Ph.D. degree at the University of Michigan in 1904. He was Botanist at the Vermont Agricultural Experiment Station from 1890 to 1899, when he became Professor of Plant Pathology at Wisconsin, where he trained many valuable men. His own work was mainly with bacterial diseases and disease resistance.

Benjamin Koehler was born in Wisc., in 1890, received the Ph.D. degree at Wisconsin University in 1925 and, after five years with the U. S. Department of

Agriculture, became field crop pathologist at Illinois.

William Henry Long was born in Texas in 1869, received the Ph.D. degree at Cornell in 1916 and became forest pathologist in the U. S. Department of Agriculture in 1911 with headquarters at Albuquerque. He retired in 1937.

Julius Matz was born in Russia in 1886, received the B.S. degree at Massachu-

setts College in 1913, was assistant plant pathologist at the Florida Experiment Station from 1913 to 1918 and then went to Puerto Rico for six years. He worked with diseases of the pecan, fig, sugar cane and citrus fruits.

Haven Metcalf was born in Winthrop, Me., in 1875, received the A.M. degree at Brown in 1897, Ph.D. at Nebraska in 1903 and was State Botanist of South Carolina from 1902 to 1906. He then became plant pathologist in the U. S. Department of Agriculture, specializing on diseases of forest trees.

Julian Howell Miller was born in Washington, D. C., in 1890, received the Ph.D. degree at Cornell in 1928 and taught at the University of Georgia from 1919 to date. He specialized on the pyrenomycetes and was probably more of a mycologist than a pathologist.

Clayton Roberts Orton was born in Vt., in 1885, received the Ph.D. degree at Columbia in 1924 and, after several positions, settled at Pennsylvania State as plant pathologist until 1929, when he went to West Virginia and in 1938 became Dean of the College of Agriculture there.

William Allen Orton was born in North Fairfax, Vt., in 1877, received the M.S. degree at Vermont in 1898, was Plant Pathologist at the U.S. Department of Agri-

culture from 1899 to 1924 and then Manager of Tropical Research.

George Leo Peltier was born at Merrill, Wisc., in 1888, received the Ph.D. degree at Illinois in 1915 and, after four years in St. Louis, became Professor of Plant Pathology in the Alabama Polytechnic for the same period, then went to the University of Nebraska. He spent considerable time on the diseases of ornamental plants and the relation of environment to disease.

Leigh H. Pennington was born in Macon, Mich., in 1877, received the Ph.D. degree at Michigan University in 1909 and taught botany several years before becoming a professor in the N. Y. State College of Forestry at Syracuse in 1914.

He was both a mycologist and a forest pathologist. He died in 1929.

Roy Gifford Pierce was born at Norfolk, Nebr., in 1884, received the M.S. degree at Michigan in 1908 and joined the U.S. Forest Service for four years, becom-

ing Forest Pathologist in the U. S. Department of Agriculture in 1913. He worked

on the chestnut canker, blister rusts and nursery diseases.

William Howard Rankin was born at Richmond, Ind., in 1888, received the Ph.D. degree at Cornell in 1914 and taught plant pathology there from 1913 to 1919. His "Manual of Tree Diseases" appeared in 1918. From 1922 to 1934 he devoted himself to research at the Geneva Experiment Station and then took charge of Dutch elm disease control.

Otto August Reinking was born in Madison, Wisc., in 1890, received the Ph.D. degree at the University of Wisconsin in 1922 and, after several years experience in Hawaii and the Philippines, became Pathologist for the United Fruit Company, with headquarters at Boston; then director of tropical research, and finally Plant

Pathologist at the Geneva Experiment Station in New York.

Arthur Stevens Rhoads was born in Philadelphia, Pa., in 1893, received the Ph.D. degree at Syracuse in 1917 and was forest pathologist at Syracuse two years and with the U. S. D. A., four years before joining the Staff of the Florida Experiment Station in 1923. He specialized on forest and citrus diseases and made a thorough investigation of Clitocybe root-rot.

Albert Joyce Riker was born in Wheeling, W. Va., in 1894, received the Ph.D. degree at Wisconsin in 1922 and studied bacterial diseases of plants there for several

years while teaching plant pathology.

Peter Henry Rolfs was born in Le Claire, Ia., in 1865 and received the M.S. degree from Iowa State in 1891. He was entomologist and botanist in the Florida Agricultural Experiment Station from 1892 to 1899 and in 1906 became its director.

George Dewey Ruehle was born in Minn, in 1898, received the Ph.D. degree at Washington State in 1930 and then came to Florida as plant pathologist at Homestead. He worked on diseases of the potato and citrus, especially melanose and scab,

and also on the diseases of ornamentals.

Hermann von Schrenk was born at College Point, N. Y., in 1873, received the degree of B.S. at Cornell in 1893, A.M. at Harvard in 1894 and Ph.D. at Washington (St. Louis) in 1897. In 1901 he became connected with the U. S. Department of Agriculture in Washington, where he and Perley Spaulding made important investigations of tree diseases and timber rots.

James Lewis Seal was born in S. C. in 1893, received the M.S. degree at Iowa

College in 1916 and, after considerable experience in teaching plant pathology, became Plant Pathologist for the Florida State Plant Board, 1925-27, and at the Glades Experiment Station from 1927 to 1929, when he went to the Alabama Poly-

technic Institution. He specialized on fruit and vegetable diseases.

Augustine Dawson Selby was born in Ohio in 1859, received the B.S. degree at Ohio State in 1893 and became botanist at the Ohio Experiment Station the following year. He was an excellent writer and his bulletins on plant diseases were among the best that came to me at Cornell, where I was wrestling with peach leaf-curl and the diseases of shade trees.

Constanting D. Sherbakoff was born in Russia in 1878, received the Ph.D. degree at Cornell in 1915, was associate plant pathologist at the Florida Experiment Station 1914-20 and then went to Tennessee. He specialized on diseases of truck

crops and vegetables.

Walter Henry Snell was born in Mass. in 1889, received the Ph.D. degree at Wisconsin in 1920 and after two years with the U. S. D. A. began to teach at Brown. He is a mycologist as well as a forest pathologist and has recently spent some time on the boleti.

Elvin Charles Stakman was born at Algoma, Wisc. in 1885, received the Ph.D. degree at Minnesota in 1913 and taught plant pathology there from 1909 to date.

He has specialized on cereal smuts and rusts.

Frank Lincoln Stevens was born in Syracuse, N. Y., in 1871 and received the Ph.D. degree at Chicago in 1900. He taught in the North Carolina A. and M. College for some years and from 1914 until his death was Professor of Plant Pathology in the University of Illinois. He was the author of two books on parasitic fungi.

Harold Edwin Stevens was born in Ky. in 1880, received the M.S. degree at Illinois in 1910 and, after considerable experience, became Plant Pathologist at the Florida Experiment Station, 1912-21, and Research Pathologist at Fort Myers in 1926. In 1928 he became senior pathologist at Orlando for the U. S. D. A. He has specialized on diseases of the avocado, mango and citrus fruits.

Neil Everett Stevens was born in Portland, Me., in 1887, received the Ph.D. degree at Yale in 1911 and became Pathologist in the U. S. D. A. in 1912, moving to Illinois University in 1936 as Professor of Botany. One of his special subjects was

climate in relation to plant diseases.

Fred Carlton Stewart was born at Clymer, N. Y., in 1868, received the M.S. degree at Iowa College in 1894, did graduate work in mycology at Cornell and joined the staff of the Geneva Experiment Station in 1894, retiring recently. He worked on diseases of cultivated plants and edible fungi.

Wilmer Garfield Stover was born in Ohio in 1881, received the Ph.D. degree at Wisconsin in 1921 and taught at Ohio State from 1912. He was a mycologist as

well as a plant pathologist.

William C. Sturgis was born in Boston in 1862, received the Ph.D. degree at Harvard in 1889 and was Plant Pathologist at the Connecticut Agricultural Experiment Station from 1892 to 1901. He specialized on plant diseases and the myxonivetes.

Charles Thom was born at Minonk, Ill., in 1872, received the A.M. degree at Lake Forest in 1897 and Ph.D. at Missouri in 1899. He taught at Missouri and Cornell, then entered the U.S. Department of Agriculture as mycological cheese

expert and microbiologist. His work was very important and practical.

William Burleigh Tisdale was born in Ala. in 1890, received the Ph.D. degree at Wisconsin in 1920, was instructor in plant pathology there, 1919–22, and Plant Pathologist at the Florida Experiment Station from 1922 to date. He specialized in tobacco diseases.

Merton Benway Waite was born in Ill. in 1865, received the B.S. degree at Illinois in 1887 and was assistant pathologist in the U. S. D. A. from 1888 to 1901,

then pathologist in charge of fruit diseases.

George Frederick Weber was born in S. Dak. in 1894, received the Ph.D. degree at Wisconsin in 1922 and began work in plant pathology the same year at the Florida Experiment Station. He is a mycologist as well as a pathologist and has in recent years been teaching forestry students on a part-time basis.

James Robert Weir was born in Ind. in 1882, received the Ph.D. degree at Munich in 1911 and has worked as forest pathologist in various positions. In 1933

he went to Brazil to advise Ford in growing rubber.

William Henry Weston Jr. was born in N. Y. City in 1890, received the degree of Ph.D. at Harvard in 1915 and taught botany there from 1921 to date. He has worked on the downy mildews of grasses, the mosaic diseases of sugar cane and the fungi of Panama.

Herbert Hice Whetzel was born in Ind. in 1877, received the A.M. degree at Wabash in 1906 and taught plant pathology at Cornell. He worked on *Botrytis* and

Sclerotinia and made mycological surveys in the American tropics.

Edwin Mead Wilcox was born at Busti, N. Y., in 1876, received the Ph.D. degree at Harvard in 1899, taught at the Alabama Polytechnic Institute 1901–08 and at Nebraska 1908–20, and died in 1931. He specialized in agricultural botany as well as plant pathology.

Frederick Adolphus Wolf was born in Nebr. in 1885, received the Ph.D. degree at Cornell in 1911, was plant pathologist in Alabama four years and in N. C. ten years, then, in 1925, became connected with the U. S. D. A. as an investigator of fruit diseases. In 1927 he became Professor of Botany at Duke University. He was

both a mycologist and a pathologist.

Harlan Harvey York was born at Plainfield. Ind., in 1875, received the Ph.D. degree at Hopkins in 1911, taught many years at Brown and West Virginia and in 1923–29 was Forest Pathologist for the Conservation Commission at Albany, N. Y. He worked on mistletoe, blister rust, and forest plantings of pine.

## CHAPTER VIII

### THE FIELD OF BOTANY

Although taxonomy naturally comes first it is not all of botany by any means. About the beginning of the present century a group of men called "Physiomorphs" were insulted if one asked them the name of a plant. This was simply a temporary

reaction to the attention paid to taxonomy in the past. Professor Atkinson's

elementary textbook dealt mainly with morphology and physiology.

Morphology relates to forms, relations, development and phylogeny. includes differentiation, evolution and adaptation. In the broad sense, physiology deals with the functions of a plant and its parts while morphology deals with their form and structure.

#### PLANT ANATOMY

This is a very large subject and forms the basis of most botanical studies of the present day, dealing as it does with plant tissues, internal structures, the division of labor, the breathing apparatus, the cambium, resin ducts and various types of

structures from simple to highly complex.

The study of plant anatomy began in the middle of the seventeenth century with the improvement of the microscope. Grew and Malpighi published illustrated works on the subject; but Linnaeus soon dominated the field of botany and it was not until the beginning of the nineteenth century that anatomy became prominent again through the studies of Treviranus, Link, Moldenhawer and Mirbel. In 1840 Hugo von Mohl founded modern plant anatomy and was followed by Nägeli, Sanio, de Bary, van Tieghem and others. The study of plant tissues from the evolutionary standpoint was begun by Russow and followed up by Strasburger, Haberlandt and workers on fossil plants, especially ferns. Systematic anatomy and ecologic anatomy are also modern developments of great importance.

# PLANT PHYSIOLOGY

The study of plant physiology began with simple organisms and it gradually became apparent that protoplasm was essentially the same in both plants and animals; but that plants manufactured food from raw materials and animals did not. Some of the earlier authorities on plant physiology were Sachs, Vines, Pfeffer, Green, Detmer, Darwin, Davenport, Bütschli and Oels. Since their day the subject has assumed great importance and many men have specialized in its various enticing fields. Some of these are listed below, with only a few from Florida. For further information see "Recent Advances in Plant Physiology" by E. C. Barton-Wright. Frank Marion Andrews was born at Vienna, Ind., in 1870, received the Ph.D.

degree at Leipzig in 1902 and taught botany at Indiana. He worked on pollen and

chlorophyll.

Charles Reid Barnes was born in Madison, Ind., in 1858, received the Ph.D. degree at Hanover in 1886 and was Professor of Botany at Purdue, Wisconsin and Chicago. He specialized in plant physiology and the mosses.

Arthur Forrest Camp was born in Los Angeles, Calif., in 1896, received the Ph.D. degree at Washington (St. Louis) in 1923 and has since been connected with the

Florida Agricultural Experiment Station, working on cotton, citrus, etc.

William Crocker was born at Medina, O., in 1876, received the Ph.D. degree at Chicago in 1906 and taught plant physiology there from 1907 to 1921, when he became Director of the Boyce Thompson Institute at Yonkers, N. Y. He worked on germination, toxic stimulation and tropisms.

Frank Earl Denny was born in Nebr. in 1883, received the Ph.D. degree at Chicago in 1916 and became Plant Physiologist at the Boyce Thompson Institute in 1923. He worked on the maturity of fruits and vegetables, dormancy in plants,

chemical stimulants, etc.

Benjamin Minge Duggar was born in Gallion, Ala., in 1872, received the A.M. degree at Harvard in 1895, Ph.D. at Cornell in 1898 and after a year in Washington became Professor of Botany at the University of Missouri. In 1907 he went to Cornell for five years, then to Washington (St. Louis) for fifteen years, and finally to Wisconsin. His special subjects were plant physiology and plant pathology.

developed a process for making artificial cultures of fleshy fungi.

Charles Stuart Gager was born at Norwich, N. Y., in 1872, received the A.B. degree at Syracuse in 1895 and Ph.D. at Cornell in 1902. From 1897 to 1905 he was Professor of Biology in the State Normal College at Albany, N. Y. After two years at the New York Botanical Carden and two more at the University of Missouri he became Director of the Brooklyn Botanic Garden, a position he held until his death. He specialized in plant physiology and botanical education, besides being an editor and author.

Rodney Beecher Harvey was born in Ind. in 1890, received the Ph.D. degree at

Chicago in 1918 and became plant physiologist at Minnesota in 1920. He worked

on enzymes of respiration and effects of cold.

Rufus Percival Hibbard was born at New Haven, Conn., in 1875, received the Ph.D. degree at Michigan in 1906 and became plant physiologist there in 1911. His special subjects were nutrition, concentration of electrolytes, cotton diseases, etc.

Edwin Fraser Hopkins was born in Buffalo, N. Y., in 1891, received the Ph.D. degree at Cornell in 1920 and taught botany there from 1925 to date. He worked

on metabolism, growth and hydrogen-ion concentration.

Charles Frederick Hottes was born in Ill. in 1870, received the Ph.D. degree at Bonn in 1901 and taught plant physiology at Illinois. He worked on the vegetable cell, effect of environment on growth, etc.

Sumner Albert Ives was born at Alfred, Me., in 1882, received the Ph.D. degree at Chicago in 1922 and taught at Furman University from 1926 to date. He worked

on the germination of holly seeds, etc.

Thomas H. Kearney was born in Cincinnati, O., in 1874 and was botanist and physiologist in the U. S. D. A. from 1894 to date. He worked on ecology, genetics

and the physiology of crop plants in arid regions.

Karl Frederic Kellerman was born in Germany in 1879, received the B.S. degree at Cornell in 1900 and entered the U. S. Department of Agriculture the following year as a plant physiologist. He directed the famous campaign against the citrus canker in the Gulf States from 1915 until its successful completion. At Cornell I found him an apt pupil. He died in 1934.

Charles Bernard Lipman was born in Russia in 1883, received the Ph.D. degree at California in 1910 and taught there to date. He worked on nitrogen fixation,

soil fertility, bacteria, etc.

Burton Edward Livingston was born in Grand Rapids, Mich., in 1875, received the Ph.D. degree at Chicago in 1901 and was Professor of Plant Physiology at Hopkins from 1909 to date. He worked on chemical stimulation, water relations,

nutrition, etc.

Daniel Trembly Macdougal was born in Liberty, Ind., in 1865, received the degree of A.M. at De Pauw in 1893 and Ph.D. at Purdue in 1897. He was First Assistant at the New York Botanical Garden from 1899 to 1904 and Assistant Director the following year, after which he was located at the Desert Laboratory in Tucson, Ariz. He specialized in the physiology of desert plants. Often he seemed more interested in putting on a show than in doing real, original scientific work.

George Thomas Moore was born at Indianapolis, Ind., in 1871, received the Ph.D. degree at Harvard in 1900 and spent four years in the U. S. Department of Agriculture as plant physiologist. From 1909 to 1912 he was Professor of Plant Physiology at Washington (St. Louis) and then became Director of the Missouri Botanical Garden. He specialized on the morphology and physiology of the algae and their relations to supplies of drinking water.

James B. Overton was born in Richmond, Mich., in 1869, received the Ph.D. degree at Chicago in 1901 and taught plant physiology at Wisconsin from 1912 until near his death in 1937. He worked on the movements of liquids and gases,

the cytology of the ascomycetes, parthenogenesis, etc. Frederick Charles Newcombe was born in Flint, Mich., in 1858, received the Ph.D. degree at Leipzig in 1893 and taught botany at Michigan from 1890 to 1923, specializing in physiology.

George James Peirce was born in Manila in 1868, received the Ph.D. degree at Leipzig in 1894 and taught plant physiology at Stanford. He worked on respira-

tion, irritability, effects of smoke, etc.

Ernest Shaw Reynolds was born at Glendale, Mont., in 1884, received the Ph.D. degree at Illinois in 1909 and taught at North Dakota Agricultural College from 1912 to 1927, when he went to Washington at St. Louis. He worked on parasitism and

resistance, and the nutritional physiology of fungi.
William Jacob Robbins was born in Nebr. in 1890, received the Ph.D. degree at Cornell in 1915, was Professor of Botany at Missouri 1919-37 and then became Director of the New York Botanical Garden. He worked on plant nutrition, tissue culture, enzyme secretion by fungi, etc. The recent expansion of plant physiology may be suggested by the fact that three botanical gardens are now directed by physiologists. Moore is at St. Louis, Gager in Brooklyn and Robbins in New York.

Jacob Richard Schramm was born in Ind. in 1885, received the Ph.D. degree at Washington (St. Louis) in 1913 and taught botany there and at Cornell before going

to Pennsylvania in 1937. He specialized on the physiology of the algae.

Forrest Shreve was born at Easton, Md., in 1878, received the Ph.D. degree at Hopkins in 1905 and from 1908 to 1925 worked in the laboratory of plant physiology at Tucson, Ariz. He was also an ecologist.

Charles Albert Shull was born in Ohio in 1879, received the Ph.D. degree at Chicago in 1915 and taught plant physiology there from 1921 to date, specializing

on germination, respiration, ascent of sap, etc.
Rodney Howard True was born in Wisc. in 1866, received the Ph.D. degree at Leipzig in 1895, was physiologist in the U.S. D. A. 1902–20 and then became Professor of Botany at Pennsylvania until his retirement in 1937. He worked on poisonous plants, the culture of drug plants and various problems in plant physiology.

Albert Fred Woods was born in Ill. in 1866, received the Agr.D. degree at Nebraska in 1913 and was for many years plant pathologist and physiologist in the U. S. D. A. He worked on enzymes, oxidation, resistance to parasites, etc.

## PLANT CYTOLOGY

When I went to Cornell in 1897 to take graduate work under Professor Atkinson my major was fertilization in the hemlock spruce and one of my minors was the histology and development of tissues in the seedlings of the same tree. Before I was there three years I had a pretty fair picture of what takes place between the planting of a hemlock seed and its formation in the cone of a mature tree. Mr. Duggar had been working on angiosperms and Miss Ferguson, at a table near mine, was incessantly spinning off paraffin ribbons from young seeds of white pine while chewing paraffin

Cytology was the fashion then. A number of American students, led by Harper, had been going to Bonn to study under Strasburger, and Professor Atkinson always tried to be at the forefront. Ikeno had discovered spermatozoids in Cycas and Webber had added Zamia to the list of plants with motile sperm cells, so why not discover centrosomes, at least, lurking about a pine or hemlock tree? Those who have seen my plates in the "Annals of Botany" recall that I did find centrosomes of a sort—big starlike structures all braced up in the cytoplasm where the ventral canal cell was cut off, and my teacher was immensely proud and pleased. After my degree was safely secured I did what many others have done, forgot my major and went ahead with one of my minors.

Cytology deals with the minute structure and function of the cell, which is the elementary unit of structure and the basis of all vital phenomena. Plant cells were first noticed by Robert Hooke in 1665, the importance of protoplasm was first recognized by Hugo von Mohl in 1846 and the nucleus was discovered in the plant cell by Robert Brown in 1831. In 1838 Schleiden showed that all plant organs are built up of cells, even though there may be division of labor among various organs.

Some of the subjects of study in plant cytology are nuclear division, mitosis, reduction, fertilization, protoplasm and its contents, and special cells for special functions. The literature of the subject is rapidly growing. Among the authors one finds such names as Blackman, Bütschli, Farmer, Flemming, Gardiner, Grégoire, Hirase, Ikeno, Nawaschin, Salter, Scott, Strasburger, Wager, Wilson and Zimmermann. A few of our American workers are listed below.

Charles Elmer Allen was born in Wisc. in 1872, received the Ph.D. degree at Wisconsin in 1904 and taught botany there from 1901 to date. He worked on the

cytology of the larch, lily, algae, mosses, etc.

Charles Joseph Chamberlain was born at Sullivan, Ohio, in 1863, received the Ph.D. degree at Chicago in 1897 and studied a year at Bonn. He was a teacher of plant morphology and cytology at Chicago from 1897 until his retirement in 1931.

He explored widely and published frequently, his specialty being the cycads.

John Merle Coulter was born in China in 1851, received the Ph.D. degree at Indiana in 1882 and after several other teaching positions became Professor of Botany at Chicago in 1896. He was very active there, organized a large department and sent out many fine workers. His own specialty was the morphology of gymnosperms and angiosperms. From 1875 he had been Editor of the Botanical Gazette. In 1925 he left Chicago for the Boyce Thompson Institute, where he remained until his death in 1928.

Bradley Moore Davis was born in Chicago in 1871, received the Ph.D. degree at Harvard in 1895 and taught botany at Pennsylvania 1911-19, then went to Michi-

gan. He studied the cytology of cryptogams.

Margaret Clay Ferguson was born at Phelps, N. Y., in 1863, received the Ph.D.

degree at Cornell in 1901 and then taught botany at Wellesley. Her work on fertilization in the white pine was outstanding. She also studied the cytology and

genetics of *Petunia*, a distinctive Florida flower.

Robert Almer Harper was born at Leclaire, Iowa, in 1862, received the degree of A.M. at Oberlin in 1891 and Ph.D. at Bonn in 1896. He was Professor of Botany at Wisconsin from 1898 to 1911, when he accepted a similar position at Columbia. Although interested in the cytology of the fungi and certain other lines of investigation he was primarily a teacher of advanced students. I heard at Bonn that the

American students there learned more from him than they did from Strasburger.

David Myers Mottier was born at Patriot, Ind., in 1864, received the Ph.D. degree at Bonn in 1897 and taught botany at Indiana from 1891 to date. He specialized in plant morphology and cytology. His drawings were perfect.

Winthrop Osterhout was born in Brooklyn, N. Y., in 1871, received the Ph.D. degree at California in 1899 and taught botany at Harvard from 1909 to 1925, when he went to the Rockefeller Institute. He worked on spindle formation, fertilization, etc. His death occurred in 1937.

John Henry Schaffner was born in Ohio in 1866, received the A.M. degree at Michigan in 1894 and taught botany at Ohio State from 1897 to date. He studied the cytology of various angiosperms, the nature and control of sex, and phylogeny.

### PLANT GENETICS

Mendel's scheme of inheritance provided both a working basis and a guiding hypothesis to plant breeders. DeVries extended the theory to include mutations. Then mendelian characters were associated with chromosomes and genes, and experiments in polyploidy were begun. The progress of this new science has been so rapid that only the briefest notice can be taken of it here. The reader is referred to "Recent Advances in Plant Genetics" by Sansome and Philip, published in 1939. It contains a very extensive bibliography on the subject. A few American geneticists are listed below. I knew Burbank, DeVries and several other prominent plant breeders in Europe better than I do those in Florida.

Edgar Anderson was born in N. Y. in 1897, received the Sc.D. degree at Harvard in 1922 and the same year became geneticist at the Missouri Botanical Garden,

where he worked on self-sterility and geographical variation.

Ernest Gustaf Anderson was born in Nebr. in 1891, received the Ph.D. degree at Cornell in 1920 and taught genetics at the California Institute of Technology from 1928 to date, specializing on maize.

John Belling was born in England in 1866, was assistant botanist at the Florida Experiment Station 1907-16, cytologist at Cold Spring Harbor 1921-29 and then

went to California as geneticist.

Albert Francis Blakeslee was born at Geneseo, N. Y., in 1874, received the Ph.D. degree at Harvard in 1904 and was connected with the Station for Experimental Evolution on Long Island from 1912 to 1941, when he resigned. His specialty was

plant genetics.

Thomas Bregger was born at Quincy, Ill., in 1888, received the Ph.D. degree at Cornell in 1928 and after holding various positions in the U. S. and in tropical America as geneticist became physiologist at the Everglades Experiment Station in

Florida. He worked on the breeding of corn and sugarcane.

Fred Harold Hull was born in Mo. in 1898, received the Ph.D. degree at Iowa State in 1934 and became Associate Agronomist in the Florida Experiment Station in 1927, working on the genetics of maize and peanuts.

Eugene Peter Humbert was born in Iowa in 1881, received the Ph.D. degree at Cornell in 1910 and taught plant breeding at Texas A. & M. College from 1916 to date. Claude Burton Hutchison was born in Mo. in 1885, received the M.S. degree

at Harvard in 1917, taught plant breeding at Cornell 1916—22 and became Professor of Agriculture at California in 1928.

Ernest Walter Lindstrom was born in Chicago in 1891, received the Ph.D. degree at Cornell in 1917 and became Professor of Genetics at Iowa State in 1922, specializing on maize, corn and tomatoes.

George Harrison Shull was born in Ohio in 1874, received the Ph.D. degree at Chicago in 1904 and becane Professor of Botany and Genetics at Princeton in 1915.

Arlow Burdette Stout was born in Ohio in 1876, received the Ph.D. degree at Columbia in 1913 and has been at the N. Y. Botanical Garden since 1911, working on various important problems in genetics. Many of his new day-lilies are grown

in Florida.

Herbert John Webber was born at Lawton, Mich., in 1865, received the A.M. degree at Nebraska in 1890 and Ph.D. at Washington (St. Louis) in 1901. He was for some years with the U.S. Department of Agriculture and afterwards at the University of California. He specialized in plant physiology and plant breeding and worked on the cytology of *Zamia* and *Ginkgo*.

The journal "Genetics," inaugurated in 1916 and managed at the Brooklyn Botanic Garden, is a periodical record of investigation in heredity and variation.

#### PLANT ECOLOGY

Plant ecology deals with the relations of plants to their habitats, which may be geographical, physical or biological. It includes the study of plant communities and ecological adaptations. This important field has developed immensely in recent years. A few of the men who have specialized in it are listed below.

William L. Bray was born in Ill. in 1865, received the Ph.D. degree at Chicago in 1898, taught botany at Texas 1897-1907, then went to Syracuse. He worked on

ecology in Texas and the development of vegetation in New York.

Frederic Edward Clements was born in Lincoln, Neb., in 1874, received the Ph.D. degree at Nebraska in 1898 and taught botany there several years. From 1907 to 1917 he was Professor of Botany at Minnesota, then became research ecologist with the Carnegie Institute. See "Plant Ecology" by Weaver and Clements and "Bio-Ecology" by Clements and Shelford.

Madison Derrell Cody was born in Texas in 1891, received the A.M. degree at

Southwestern (Texas) in 1915 and taught botany and bacteriology at the University

of Florida from 1919 to date. He specialized on ecology and physiology.

Frederick Vernon Coville was born in Preston, N. Y., in 1867, received the A.B. degree at Cornell in 1887 and Ph.D. at George Washington in 1921. From 1893 until his death in 1937 he was associated with the U.S. National Museum, where his investigations included economic and geographic botany and the improvement of

the blueberry. See Sat. Ev. Post for Sept. 12, 1942.

Dr. Coville influenced my life profoundly. When I told him about the graduate work I had planned in biology at the Hopkins, where I had already been given a scholarship, he advised me to go to Cornell and take botany. Dr. L. O. Howard backed him up and the two arranged it with Professor Atkinson. Their argument was that colleges were already provided with biologists but as their departments expanded a goodly number of botanists would be needed. This was in line with the trend in natural science at the close of the nineteenth century.

Henry Chandler Cowles was born at Kensington, Conn., in 1869, received the Ph.D. degree at Chicago in 1898 and was connected with the botanical department there until his retirement in 1934. His field was plant ecology and he was very active in it for a number of years. Mr. J. R. Watson, a pupil of Cowles, wrote an excellent article some years ago on Florida ecology.

George Damon Fuller was born in Canada in 1869, received the Ph.D. degree at Chicago in 1913 and taught ecology at Chicago from 1909 to date. He specialized on the forest ecology of Illinois, the transition of grassland and forest, and alpine and

sand-dune vegetation.

Roland McMillan Harper was born in 1878 at Farmington, Me., completed the undergraduate course at the University of Georgia in 1897 and in 1903 became forestry collector for the Geological Survey. After receiving the Ph.D. degree at Columbia in 1905 he was mostly in the employ of the State Geological Survey of Georgia, Alabama or Florida as botanist or geographer and explored all three states quite thoroughly. He published two bulletins on the distribution of Florida plants.

John William Harshberger was born in Philadelphia in 1869, received the Ph.D. degree at Pennsylvania in 1893 and taught botany there until near his death in 1829.

He specialized in ecology.

Duncan Starr Johnson was born at Cromwell, Conn., in 1867, received the Ph.D. degree at Hopkins in 1897 and taught botany there until near his death in 1937.

He specialized in embryology and the ecology of marine algae.

Herman Kurz was born at Cedar Rapids, Ia., in 1886, received the Ph.D. degree at Chicago in 1922 and taught botany from that time to date at the Florida College for Women. He specialized on plant morphology; the hydrogen-ion in relation to ecological factors; phenology; and freezing experiments.

Walter Byron McDougall was born in Mich. in 1883, received the Ph.D. degree at Michigan in 1913 and taught botany at Illinois from that time until 1929. He

George Elwood Nichols was born in Conn. in 1882, received the Ph.D. degree at Yale in 1909 and taught botany there from 1904 to date, specializing in forest ecology and bryophytes.

Frank Thone was born at Davenport, Ia., in 1891, received the Ph.D. degree at Chicago in 1922, taught botany a year at the University of Florida and joined Science Service in 1924. He specialized in ecology and scientific journalism.

The journal "Ecology," inaugurated in 1920 by the Ecological Society of

America, is managed at the Brooklyn Botanic Garden.

One of the best brief accounts of the various plant habitats found in Florida is in Small's little book on the ferns of the state. Every plant collected for reference or study should be accompanied by habitat notes, otherwise its value is greatly lessened. Too many herbaria are largely filled with "trash," either because the specimens are poor and scrappy and represent only one stage, or because they lack proper and sufficient data. Another bad habit is the use of duplicates to make a good impression, when all such material should be laid aside for exchange or free distribution to schools.

My own work in Florida ecology has been mostly limited to the violets and hawthorns of the state and to plant communities in Alachua Co., where I have carefully listed the species and their relative abundance. I also traveled thousands of miles to study the environment and distribution of Bartram's Ixia, a beautiful flower that is disappearing. Dr. A. M. Laessle has recently published an excellent paper on the plant communities of the Welaka Area in Putnam Co., where he found 750 species of vascular plants. Studies of this kind are greatly needed in other

parts of the state.

## CHAPTER IX

# BOTANICAL EDUCATION IN FLORIDA

Botany is no longer a study simply for girls or loafers looking for a "snap." When taught as a foundation for other subjects it can be very unattractive and difficult because of its nomenclature and terminology, but as a cultural course it should be interesting. The proper way to begin such a course is with the living plants, observing their differences, learning their names, making pictures of them, getting together a collection of pressed specimens and becoming acquainted with their life history and ecology. Form and function are both important, just as pure and applied botany should go hand in hand. Taxonomy provides excellent training in accurate observation and description. As one grows older he realizes that vegetation is the basis of all animal life and the continued existence of human beings, forming a large and essential part of the human environment. A knowledge of botany is considered necessary to courses in horticulture, forestry, park management, phytopathology and entomology, but it may be even more important as a contribution to general culture and spiritual contentment.

Few native Floridians have paid much attention to botany as a pure science. There are several good reasons for this. The elementary schools have provided for little or no nature-study, largely because there were no available teachers and no textbooks dealing with Florida plants. The salaries were too low to attract northern teachers and even they would have been ignorant of the local vegetation. Hence children grew up in ignorance of their natural surroundings just at the age when

nature-study would have been most natural and most appealing.

The libraries in Florida have had little to offer either children or adults on the subject of botany that was both attractive and suitable. Books written by northerners rarely included much knowledge of Florida plants for the simple reason that they did not know much themselves. Visitors to Florida carried a lot away but never sent anything back, and their writings were usually too scattered to be readily available. Those who have settled in Florida have worked under great disadvantages; lacking literature, authentic specimens for comparison, and even the sympathy and help of congenial workers in the same field.

Native Floridians who have left Florida have usually remained away because of higher salaries or other incentives, and in this class were many of the most intelligent and progressive individuals. Florida attracts many persons of advanced age, but they rarely possess the initiative or desire to do any real scientific work. If they collect specimens they have a hard time preserving them, and it is still more difficult in many cases to learn their names. So they give it up and just sit in the sun and

watch the world go by.

The native Floridians who have remained at home, even though intelligent and zealous, have met with many obstacles in trying to learn the native flora. Here again the lack of books, collections and other facilities has been outstanding, and self-teaching under the best conditions is not very inspiring. The isolated student is rarely sure of his ground. He becomes accustomed to uncertainty and is apt to develop an unpleasant complex which weakens his initiative if it does not discourage him entirely. A northerner coming to Florida already equipped with a fair knowledge of plants is in a far better position to work intelligently and confidently, especially when he can return to his library and herbarium and check up his collections and observations.

Families having intelligence and initiative have been developed through centuries of endeavor under the best conditions. One does not expect many great men in a young state where there is still much ignorance, poverty, disease, poor facilities and lack of stimulus to greatness. It is quite difficult to be a great botanist without

first being a great man, or having the makings of one.

Some men are born teachers, able to train and inspire scores of workers; others are investigators, well content to work alone and unfitted to impart either their methods or their enthusiasm. Some individuals cannot work alone but must have a partner or assistant; others can direct work but seem averse to doing it themselves. The main thing is to get the work done, and to give due credit for it. Executives live for a few years at a higher salary and with more prominence but even their memory soon vanishes from the earth; while the poor obscure discoverer of a new plant may live forever. Men of means often accomplish more because they can buy materials and assistance, travel and explore, and publish their findings in good form. Fries was a famous mycologist partly because, unlike Persoon, he was wealthy enough to have handsome illustrations made. He copied the work of men much more original and painstaking than himself and had several books to his credit. If he wished, he changed the original name to one of his own selection. Such is the progress of science. As in other fields of endeavor, justice is a hit-and-miss affair.

### PUBLIC SCHOOLS

There are over 2,000 public elementary schools in Florida and more than 300 public high schools. In the latter there is a brief course in biology but its value depends largely upon the preparation of the teacher. Great advances have been made in nature teaching in recent years. There are available attractive reference books, wall charts, pressed specimens, school gardens, colored lantern slides, colored motion pictures and even compound microscopes. Such things any school can have if funds are on hand to buy them and if the teacher has sufficient training to want them and to make use of them. Pupils are eager to collect specimens. Duplicate sets of pressed plants can be sent to some authority for naming, and soon the school will have a nice collection of local plants. Then, by exchange or otherwise, specimens may be obtained from other localities having a different flora. Pupils can easily make scrapbooks of leaves and flowers for themselves which will be useful all their lives. Many a life has been made happy in old age because of some early and pleasant association with the beauties and wonders of nature.

#### HIGHER INSTITUTIONS

The teaching of botany in the colleges and universities of the state varies con-

siderably. This will be seen in the following descriptions of courses offered.

The Florida Agricultural and Mechanical College for Negroes was established in 1887 and four years later moved to Tallahassee. The enrollment for 1941 was 900. The Professor of Biological Science was Dr. F. D. Inge, who studied at Minnesota and did graduate work at Iowa State. Courses are offered in Botany, Field Botany and Bacteriology and Hygiene. The first covers the fundamental principles for advanced or practical work with plants. Representatives of the principal groups of plants are studied with emphasis upon their structure, function, development, heredity, and relationship to man.

Field Botany deals with the identification and general study of plants in the field, floral morphology, and the use of keys. The third course includes the mor-

phology, physiology, and development of the bacteria, yeasts, and molds including discussions of the industrial and hygienic applications of bacteriology.

Florida Southern College is located on Lake Hollingsworth in Lakeland. 1941 the enrollment was 1,063. Dr. Maurice Mulvania, of the University of Wisconsin, had charge of the biological work, with Dr. Vernon S. Gentry and Dr. John Stewart as associates. Courses were offered in General Biology, covering both animal and plant forms; General Botany, dealing with plant groups; Plant Anatomy, restricted to flowering plants; Plant Physiology; Taxonomy, dealing mainly with the local flora; and Mycology and Plant Pathology, introducing the major groups of fungi and the more common cultural methods.

The Florida State College for Women was opened at Tallahassee in 1905 and in 1941 had an enrollment of 2,800. Dr. Herman Kurz was Professor of Botany and Dr. Ruth O. Schornherst Assistant Professor. Undergraduate courses are offered in General Botany, Plant Physiology, Spring Flora, Plant Morphology, Plant Anatomy, Plant Pathology and General Bacteriology. A greenhouse and arboretum are important additions to the usual equipment for such courses. Graduate work is given

in Ecology, Morphology and Systematic Botany.

Rollins College was incorporated in 1885 and in 1941 had an enrollment of 430. It is located on Lake Virginia in Winter Park four miles from Orlando. Dr. Uphof is Professor of Botany and Miss Shor his assistant. Courses are offered in General Botany, Plant Physiology and Anatomy, Systematic and Economic Botany, Horticulture and Bacteriology. There is a plant sanctuary of one hundred acres and a museum of natural science which contains the herbarium and scientific library of Mrs. Mary F. Baker.

John B. Stetson University, at Deland, had an enrollment in 1941 of over 1,000 students. Dr. Harvey E. Savely, of Duke University, had charge of the biological work, which included courses in General Botany, Genetics, Bacteriology and Systematic Botany. This last covered the identification and distribution of flowering

plants with the fundamentals of plant ecology.

The University of Miami, at Coral Gables, was opened in 1926 and has made rapid growth. In the Faculty are Dr. John C. Gifford, Dr. Taylor R. Alexander and Dr. Robert H. Williams. Mr. Walter Buswell is in charge of the herbarium. The courses offered are many and varied: General Botany, Local Flora, Economic Botany, Comparative Morphology, Plant Anatomy, General Bacteriology, Genetics, Plant Physiology, Marine Botany, Ecology, Plant Pathology and Plant Behavior. The herbarium contains about 30,000 specimens of flowering plants.

The University of Tampa has a short course in introductory botany and offers one in systematic botany dealing with the local seed-plants. The herbarium is still

very small.

The University of Florida, located at Gainesville, has a Biological Department with Professor Rogers in charge and a Botanical Department with Dr. W. B. Tisdale as head. A general course in Natural History is given by T. H. Hubbell, Professor of Biology, designed to prepare teachers for nature-study work in the state. A course in Genetics and Evolution, largely from the animal side, is given by Professor Rogers.

The Professor of Bacteriology, W. R. Carroll, gives a course in General Bacteriology and special courses in Soil Bacteriology, Water Bacteriology, and Dairy

Bacteriology.

The Professor of Botany, M. D. Cody, gives courses in General Botany, Plant Physiology, Plant Histology, Advanced Plant Anatomy and problem work in Tax-

onomy, Physiology and Histology.

The School of Forestry, with a capable Faculty headed by Professor H. S. Newins, gives courses in Dendrology, Silviculture, Forest Pathology, etc., with much work in the woods. Students cannot fail to learn a great deal about Florida trees.

#### FLORIDA EXPERIMENT STATION

The Florida Agricultural Experiment Station was established in 1888 and has been of the greatest importance in the development of both pure and applied botany. In introducing and testing new grasses and clovers for pastures, new legumes for cover crops, and new varieties of fruits and vegetables for the market, a wide and accurate knowledge of plant groups and species has usually been necessary. In plant breeding, also, the principles of plant morphology and cytology are essential. Those who have worked on better or more resistant varieties of corn, cane, oats, tomatoes, tobacco, watermelons, pecans, citrus, tung-oil, camellias and other plants

have prepared themselves by years of study in pure science fundamental to the

practical side of plant breeding.

The same is true in plant pathology. Taxonomy comes first, not only as regards the parasitic fungi but also their hosts. The herbarium of host plants and fungi has been built up by Mr. Erdman West, mycologist, and consists of over 60,000 specimens safely housed in steel cases. The Main Station at Gainesville has eight research departments and there are five branch stations and seven field laboratories located at key points in the state. From all these material is continually being sent in for determination. There is no intention, however, of enlarging the host collection beyond the special needs of the mycologist and agronomist. To do so would be a waste of time and money, since any research work in the taxonomy of flowering plants must be done in northern herbaria where authentic material and huge accumulations of field records are available.

### LIBRARIES

In 1935 there were 49 free public libraries in Florida with 588,000 books. In 41 counties there were none. Prior to the Civil War no free library existed in the state. The total book collections at the colleges amount to about 275,000 volumes.

#### MUSEUMS

There are ten museums in the state, five of which are scientific. None contain botanical collections of importance.

#### HERBARIA

The herbaria in the state are few and small, and it will probably be many years before one is established on a scale sufficient for research in taxonomy. The best we can do at present is to utilize the space we have for worthwhile collections instead of filling it up with anything that comes to hand without reason or plan. Only samples of northern species should be included, for purposes of identification. The

duplicates should be used in exchange or distributed to the schools.

Rare Florida plants should be well represented in different stages and variations with full data on their labels, including habitat, color, size, abundance, etc. A student using the herbarium should find something of real value besides the date and place of collection. Common Florida species should be collected near the northern or southern limits of their distribution, together with stages and variations. To mount a specimen from each county is a waste of time, space and money. The state distribution may be listed by counties if desired or checked on a small map. Here, again, duplicates may be exchanged or given to schools.

In distributing pressed specimens to schools in the state full instructions should be given on how to collect, press, mount, label, file and preserve them from insect ravages. Also where to buy supplies, what books to select and how to make duplicate sets for exchange. Even a few plants thus distributed may be of immense help in teaching and also in stimulating pupils to further interest in botany.

## PARKS AND GARDENS

The best and most pleasant way to learn plants is to see them growing under natural conditions. A nature trail in a park with labels on a number of the plants suits those who wish to commune with nature in solitude. Others prefer a party and a guide, who should be enthusiastic and experienced as well as informed on the subject matter and methods of nature-study. The park naturalist should be well paid if he is efficient.

Florida's state park system is only a few years old but already much has been

accomplished and more is contemplated. Here is a list of our state parks.

Hugh Taylor Birch—at Ft. Lauderdale. Rare tropical plants.

Camp O'Leno-North of High Springs on Santa Fé River. Interesting woodland area.

Florida Caverns-near Marianna. Natural rock gardens and dense hardwood

Fort Clinch—near Fernandina. Ocean beach, sand dunes and hammock forest. Gold Head Branch—near Keystone Heights. Rolling sandhills, freshwater lakes, open pine forest and a deep ravine with hardwood trees and nature trails.

Highlands Hammock—near Sebring. Dense subtropical forest, nature trails and arboretum. Some of the trails are named "Laurel Oak," "Fern Garden,"

"Pine Hammock" and "Hickory Trail." The arboretum and botanical garden now under development contains 1,500 acres of state-owned land.

Hillsborough River-near Zephyrhills. Dense subtropical forest of 820 acres

along the river with attractive trails.

Myakka River-near Sarasota. A forest area of 13,000 acres containing two lakes and a portion of the river.

Pan-American—near Ft. Lauderdale. Subtropical vegetation in 2,000 acres of

Suwannee River-near Ellaville. Forest along Suwannee and Withlacoochee Rivers.

Tomoka-near Ormond. Hammock at the confluence of Halifax and Tomoka

Rivers.

Torreya-in Liberty County between Bristol and River Junction. High wooded bluffs overlooking the Apalachicola River. Dense forests of splendid trees, including the rare Florida torreya and the Florida yew.

Royal Palm—at the tip of the Florida peninsula in the tropical zone. A ham-mock containing such trees as the strangling fig. the gumbo limbo and the royal palm,

with countless air-plants, vines and ferns.

#### FORESTS

National forests in Florida are few but extensive and extremely interesting. Apalachicola—southwest of Tallahassee, extending to the Apalachicola River. Over 600,000 acres of pine and hardwood forest.

Choctawhatchee—in the extreme western part of the state. Over 360,000 acres of virgin longleaf pine, swamp lands, hardwood stands and several shrubs and trees

of the Appalachian region.

Ocala—between Ocala and Daytona Beach. Over 440,000 acres of prairie and forest land containing sand-pine and many hardwoods with rosemary, garberia. coontie, etc. At Juniper Springs there is a low hammock with a beautiful nature

Osceola—located in northeastern Florida near the Georgia line. Over 160,000

acres of forest containing longleaf and slash pine, cypress and hardwoods.

There is a state forest called the Cary Forest, located in Nassau and Duval Counties. It contains about 3,000 acres of longleaf and slash pine. forests are known as Blackwater River, Pine Log. Myakka River and O'Leno.
The Austin Cary Memorial Demonstration Forest, in Alachua County, is used

by forestry students at the University for field work. It contains 2,000 acres of flatwoods, with longleaf and slash pines, pond cypress, scrub oak, gallberry, saw palmetto, etc.

The Everglades National Park, still undeveloped, covers most of the southern end of the state, with 1,450,000 acres of rich and varied tropical vegetation, including

an abundance of orchids.

County parks have been developed in Dade, Orange and Gadsden Counties. Kelly Park, with 200 acres, was donated by Dr. H. A. Kelly, of Baltimore. It contains Rock Springs.

GARDENS

Chapman Field, south of Miami, is used for plant introductions. Other gardens in the state are:

Azalea—at Orlando.

Azalea Ravine—at Palatka, with hundreds of thousands of azaleas in cultivation. Cypress—near Winter Haven, with gardenias, camellias, azaleas, etc. in a setting of live-oaks and cypresses.

Dupree—near Tampa, with 25 acres of floral loveliness hardly surpassed. Eagle's Nest-at Clearwater, patterned after an old English garden.

McKee Jungle-near Vero Beach, with 80 acres of tropical jungle enhanced by the addition of tropical plants from all parts of the world. Mead—at Winter Park.

Oriental-at Jacksonville, with 18 acres of Asiatic plantings.

Sarasota Jungle-at Sarasota.

Tropical-at Ormond. Tropical-at Miami.

Turner's Sunken Gardens-at St. Petersburg, with 6 acres of royal palms, bougainvilleas and many other attractive plants.

#### THE VALUE OF BOTANICAL GARDENS

Florida, with her superb climate and various habitats, should have several wellplanned botanical gardens. Few people realize the importance of such institutions. Plants are the ultimate source of all our foods and even maintain the supply of oxygen in the air we breathe. Our houses, clothing, fuel, drugs, and many articles so necessary to modern life are mostly of plant origin. Hence the value of a garden where various plants may be grown and their products exhibited. Botanical gardens are places of beauty also, where one can quietly rest and enjoy the great variety of

fascinating forms and colors nature so richly provides.

The educational value of such institutions is outstanding. Through lectures, labels, walks, demonstrations, publications, correspondence, library facilities, and simple observation thousands of persons receive both information and inspiration in the broad and useful fields of pure and applied botany. When a woman plans to plant a garden she first sees how the experts do it. When a young man wishes to become a trained gardener he knows where such training can best be obtained. When scientific botanical research is desired the botanical garden offers a library, museum, herbarium, greenhouses, laboratory and facilities for cultivation and experimentation, with experts to give advice and assistance. How can a university or college afford to be without a botanical garden?

### HELP AND ENCOURAGEMENT

Although our plants were collected first in the southeastern United States they were thoroughly studied and understood only after botany had developed in the north. The New York Botanical Garden has done much for Florida botany. The work of Small and other members of the Staff; publications like "North American Flora" and "Addisonia": living plants grown under glass where they could be observed; and numerous articles and books written by men connected with the Garden prove this beyond doubt. Many Florida plants are in the vast herbarium there of over two million specimens, and many more are growing in the extensive greenhouses.

The Missouri Botanical Garden is also a great institution but its men have taken more interest in the great unworked region west of the Mississippi. At the Arnold Arboretum some southern woody plants are grown but their number is necessarily limited by the climate. The U.S. Department of Agriculture has played a conspicuous part in the development of Florida botany, especially in such subjects

as agronomy and plant pathology.

Among periodicals the "Torrey Bulletin," "Botanical Gazette" and "Mitchell Journal" have a prominent place. Also Peck's "Annual Reports," the "Journal of Mycology" and "Mycologia." Many others might be mentioned, including a number published in Europe. In recent years our own state has been publishing

quite extensively

The Garden Clubs, primarily horticultural and social, have fostered an appreciation of plants and the protection of rare wild flowers. The Gainesville Nature Club has set a good standard for the study and appreciation of wild life by taking an excursion once a week to some attractive locality. It is to be hoped that such clubs will be formed in other parts of the state. All agencies that encourage and popularize a subject are helpful. Most individuals like to follow the fashion, or at least to have the approval and sympathy of others.

## CHAPTER X

### FLORIDA TOMORROW

Florida is a young state in many ways but one with great possibilities. The near future doubtless has in store many improvements and not a few surprises. We may not strike much oil or coal or precious metal but there is plenty of phosphate, limestone, clay, sand and water. Who knows how many of the crops of the future will be grown simply in white sand or water? Revenue from fish alone may reach gigantic proportions. The Everglades have a great future. Our forests can be made much more productive under scientific management, yielding both timber and

The red scourge of fire will sometime be banished.

More magnificent parks will provide recreation and instruction in nature-study throughout the year. Botanical gardens will be developed by the colleges and smaller gardens by the schools. Every city and town will have a system of parks, parkways and choice shade trees, all managed by an independent committee of responsible citizens instead of being subject to the whims of politicians. Statues will be placed in these parks without fear of defacement and flowers will not need fencing, because the love of beautiful things will be taught both in the home and the school. The pioneer attitude toward trees as enemies will be changed to one of admiration and delight.

Horticulture has made great advances in the past but many more are still to come. With better fungicides and more immune varieties there will be better crops at reduced cost. New fruits will be introduced and some of our wild ones improved. Tung-oil trees that bloom after the spring frosts and produce more nuts with greater oil content are a certainty. It only takes a little time.

The highways will have at least four tracks and roadside planting will be the rule rather than the exception. Oranges, pecans, and rare flowering trees will form part of this plantation for the benefit of travelers. There will be no railway crossings and no cows or hogs or buzzards. Signs, too, will have ceased to be a nuisance.

Hunting and fishing will attract many, while others will come with cameras and books to enjoy and study wild life under the most favorable conditions. Mosquitoes will be practically unknown except in remote districts. Malaria will disappear, and hookworm and certain other diseases. In summer there will be air conditioning and in winter sun heating. Swimming pools and sun baths will be available everywhere,

most of them free to the public.

Loud and jarring noises, so injurious to the nerves even when not noticed, will be largely eliminated in our cities. Children, however, must play and shout in order to develop properly; so families with children will live together in communities provided with playgrounds, swimming pools and small parks with flower gardens and collections of birds and wild animals, where they can enjoy life without disturbing older, more sensitive persons. They will have their pets too but only small ones and these will be kept under rigid inspection and regulation to prevent insects and diseases. All the larger animals, large dogs, functionally female dogs and cats, and chickens will be excluded from cities and towns. Moreover, dogs will be treated surgically to prevent barking, and burglar alarms will be substituted. Families with children rarely have anything to steal anyway. Of course, the ideal place to raise a family is in the country, and Florida is a state where great open spaces still exist.

The public school system will be vastly improved. Teachers will be well paid and have plentiful supplies. Every child will be taught nature-study. Collections of plants, insects, etc. will be supplied that represent things they see every day, and their books will deal with Florida material. At the larger colleges courses in naturestudy will be provided for teachers. Libraries will be adequate and museums replete with local exhibits of educational value. Families will move to the state to send their children to school. Great teachers and research men will be attracted by the salaries and improved conditions, as well as by the climate. Endowments

will come, and scholarships, and gifts of books and works of art.

Florida's geographical position insures her a great future. She will draw both from the north and from the south. She will provide both homes and playgrounds; while every itinerant and migrant will pay her tribute. Florida was discovered by a man seeking the Fountain of Youth. She has proved to be this and more; and she is destined to become a modern Utopia.

#### CHAPTER XI

## THE WORLD TOMORROW

The Earth seems destined to support human life much longer than formerly supposed. The sun's energy will hold out; oil and minerals are sufficient for at least a thousand years; there will be no lack of land and food; and the families will be smaller. Toward the end of the present century the United States will probably have its

maximum population, of about 150 million.

Scientists will discover new sources of power, such as atomic energy, while making greater use of the wind, sun, and especially the tides. From the ocean will also come vast quantities of minerals. Great discoveries and inventions lie ahead of us. Even our foods will be almost totally changed in a few decades. New drugs will be discovered; vitamins and hormones will be extensively used; and most diseases will be conquered.

Man will probably continue to inhabit the Earth for half a million years or more, and may migrate to Venus. But his future is in his own hands. Animals in the past have reached a high state of development and then disappeared altogether or were succeeded by a higher type of descendant. If man is to prove an exception to the

rule he must recognize at once his limitations and do something about it.

Human beings have certain distinct advantages over other animals, such as intelligence, language, knowledge, science and adaptivity. The present civilization is also superior to those of the past in being able to discern the causes of its decay and to find a remedy. What are some of the signs of decay and their causes?

In the first place, man has become weaker physically. What a pitiful percentage are fit to fight! In spite of all our boasting, not a day has been added to the span of human life; only more babies have been saved, many of them not worth it. Self-indulgence and poisons have ruined many, while inviting diseases difficult to over-

come.

In mind and morals, also, the human race is on the decline in several ways and for several reasons. The study of inert matter has progressed far beyond that of living matter. In a conversation with Tagore, I became impressed with the fact that we make the former far too prominent, producing a very poor environment for the development of our higher powers.

Our treatment of the mentally deficient and criminals is little less than suicidal. We know perfectly well that these people are poisoning the whole structure of society, like rotten apples in a barrel, and still we prate of "mercy." The hardened criminal should be eliminated as promptly and as cheaply as possible, while others

unfit to breed should be sterilized.

Our system of mass education is wrong. We are intensely individual and should be treated accordingly. Women are also entirely different from men, demanding a different education, and different work. Every cell in a woman's body is feminine. Higher education for women is desirable especially for the sake of her children.

No teacher can take the place of a mother.

What can be done to prevent the degeneration of the human race and its final oblivion? We have been using up the fund of strength derived from our pioneer fathers. The way to replenish it is to return to the ways that made them strong. Adaptation develops virility. Hardships, privations, struggle are necessary. What great man has not had them, or their equivalent? The individual must be rescued

by a change in the environment of his body, mind and soul.

Heredity must be purged and pointed upward instead of downward. Not only must bad and weak genes be eliminated, but every possible means must also be employed to increase the relative number of desirable genes. Eugenics can hardly be enforced but voluntary eugenics can be greatly encouraged. Once a well-born individual is discovered, every effort should be made to develop him wisely by the proper environment and an education suited to his individual needs, which include good home influences.

Longevity is desirable only if it prolongs youth, not old age, and makes for righteousness rather than vice. Barring illness, senescence may be, and should be, full, fruitful and beautiful. Rejuvenation may never be practically possible, but the most probably chance of success is in transplanting active young human glands and

acquiring pure young human blood.

Perhaps Florida and certain other Southern States might lead in this essential undertaking to save the human race, as they did in the study of American plants. There seems to be much good old-fashioned religion in the South, with regard for real culture, love of beauty and unselfishness. The true life of a human being lies in the upper brackets, where high thoughts and fine feelings are. Of what use to live long on the earth if one is no better than a pig or a mule!







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